

# COMP 4: BENCHMARK QUIZ SYSTEM

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# Analysis

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## Project Problem Definition

Client: Godalming College Physics department

- Anne Lancaster (Primary)
- Phillip Morgan and Joe McCarthy-Holland (Secondary)

Contact: Anne Lancaster  
Tuesley Lane,  
Godalming,  
Surrey,  
GU7 1RS  
(01483 423526)

## Background to the Problem

The Godalming College physics department is a small department, comprising three teachers, technicians, five lower 6th and three upper 6th classes. One of the teachers - Anne Lancaster - sets exam style starter questions at the beginning of each lesson, based on the current topic she is teaching.

The current system Anne uses is the same system the department uses to generate mock exams from the AQA question bank. Because the software is not bespoke, it lacks functionality in some areas. Questions are searched for and compiled into a document which can be printed or saved, along with a mark scheme. There are only a finite number of questions, with no way to add more or change the details of the existing ones. There is also no way to export the generated quizzes to the college's Moodle, or to keep a record of the questions which have already been set.

## Interview with Anne Lancaster - The Primary Client

What's your existing system for setting classes questions?

AL: We use AQA's Exampro to select existing questions from past papers. Sometimes we write them ourselves using word processors.

What are the benefits of using the current system?

AL: It's easy to scroll through the lists of past questions and filter them by type or unit to select the ones you want. The mark schemes are easily accessible as well, and when you've chosen a set of questions you can save them to use again with a different class.

What are the drawbacks of the current system?

AL: We're limited by the questions, because they all come from past papers there isn't any way of adding new ones into the system. There aren't many questions on certain topics which can be a problem when we're making quizzes or revision booklets. Also, the search filter could be better. It would help to be able to search by more than just the unit or topic, and have more types of questions so you could search by type. The software we use also doesn't notify us if we're about to add a question to the document that's already there.

Which new features would be the most important to you?

AL: We should be able to add our own questions to the system instead of simply using past paper ones. Being able to upload the quizzes to Moodle without having to type them out again would also be useful, so that the students could complete the quizzes in their own time and have them automatically marked in seconds rather than bringing them in or us marking them through Moodle. At the same time though, we still want to be able to print normal text documents or save them to use as paper copies.

Which existing features do you find the most useful?

AL: The existing features that I'd like to see in the new software are the ability to view and print mark schemes and search by unit or topic for questions which have already been added. It would be nice to have some sort of difficulty rating for each question generated, too.

How many members of staff would be using the new system?

AL: There are three teachers in this department.

Which course and units would you like the system to work with?

AL: AS and A2 Physics - every unit.

You mentioned different types of questions, what did you mean by that?

AL: I'd like the questions to be similar to the exam style in that there are different formats; numeric calculations, simple definitions of terms and multiple choice answers.

How would you like the students to answer these questions?

AL: Currently, I display them on the interactive whiteboard or print each student a copy and they write their answers on paper. They then swap with the person sitting next to them and mark their partner's.

## Observation of Existing System

I observed two of the teachers using the existing system to get a better understanding of how the users interact with it on a daily basis, and identify the problems they face while doing this.

NB. Due to access issues, the screenshots shown below are from the GCE Computing specification rather than GCE Physics, but other than this, the systems are identical.

The current process is as follows:

1. Questions are selected from the database
  - 1.1. The teacher looks at their paper-based records to check which chapter of the textbook their class most recently covered. There is no way of keeping a record of this from within the system.
  - 1.2. Exampro is opened, and the teacher uses the search filter to search for the relevant questions by topic [figure 1] (for broader quizzes, they searched by unit of work [figure 2]). There are few other ways to filter the questions, which for a large database can be problematic and time consuming. [figure 3]
  - 1.3. If the questions are for a starter exercise, ten are selected. [figure 4] If they're for revision booklets, it could be a hundred or more. A problem arises here, because the existing system doesn't notify the user if they're adding a question which is already in the current document.

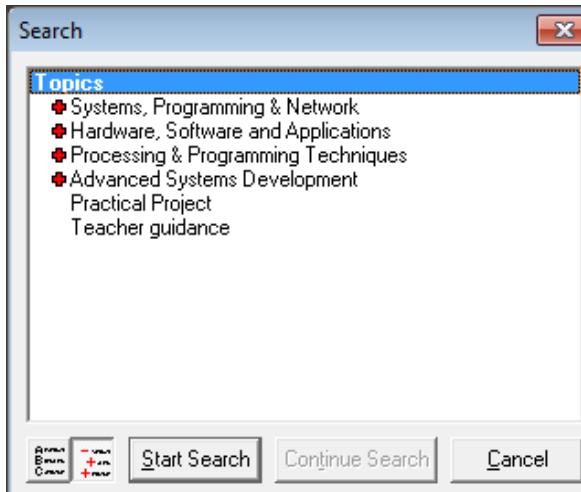


Figure 1

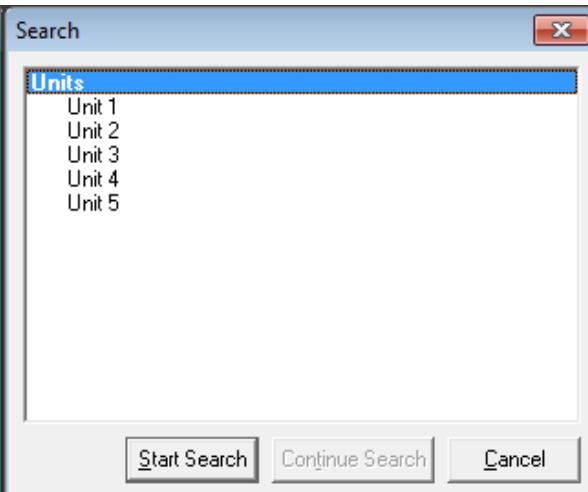


Figure 2

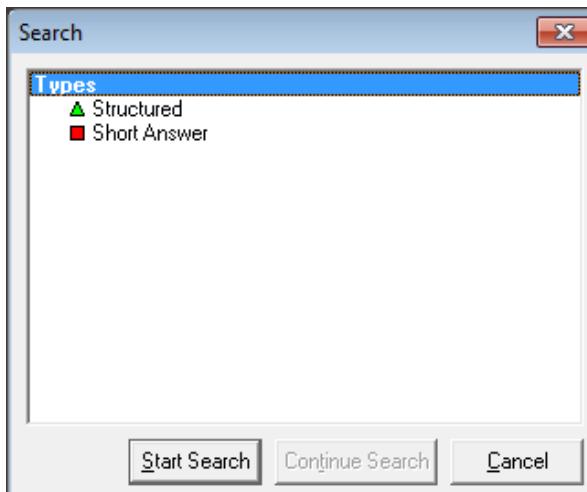


Figure 3

Untitled			
1	Q SP.1.02	▲ Fundamentals of Programming	④ [3]
	I Constructing a binary search tree		
2	Q S99.A2.13	▲ Fundamentals of Computer	⑪ [7]
	I Low level languages		
3	Q S00.N2.09	▲ Applications & Effects, Networks	⑨ [6]
	I Data Protection Act/Computer Misuse Act/encryption		
4	Q S00.N2.10	▲ Operating Systems	⑨ [6]
	I Batch/interactive		

Figure 4

## 2. Questions are checked against existing quiz documents

- 2.1. If the topic has taken more than one lesson to teach, the teacher opens the previous quizzes to check that none of the questions they selected have been assigned before.
- 2.2. If there are any duplicates, the teacher replaces the questions.
- 2.3. The questions [figure 5] and generated mark scheme [figure 6] are saved. There are alternative options, such as to print them, but no option to export them in a format compatible with the college's online Moodle.

The main window is titled 'Viewer' and shows a table titled 'Elements of LIST' with 10 columns labeled 1 through 10. The first row contains values 43, 27, 30, 84, 19, 63, 58, 92, 48, 14. Subsequent rows show the state of the list after each pass of the algorithm. A note at the bottom says 'I mark for each of rows 1, 2, 4, 5, 6, (Final list 27 30 43 19 63 58 84 48 14)'.

A separate window titled 'Mark Scheme' lists various topics with checkboxes. The following topics are checked:

- SP.1.09 Defn. of parameters & local variables/reasons for use
- SP.1.10 Tracing of a bubble sort algorithm
- SP.2.01 Advantages/disadvantages of computerised ID card/passport
- SP.2.02 Defn. of security/integrity methods to protect data
- SP.2.03 Formula in cell using absolute/relative referencing
- SP.2.04 Input devices/user interface/input data/data sources
- SP.2.05 DBMS/program-data indep./data consistency/redundancy
- SP.2.06 Directory structure/path names/directory tree
- SP.2.07 Real time/batch multi-programming op. system
- SP.2.08 Definition & characteristics of algorithm

Figure 5

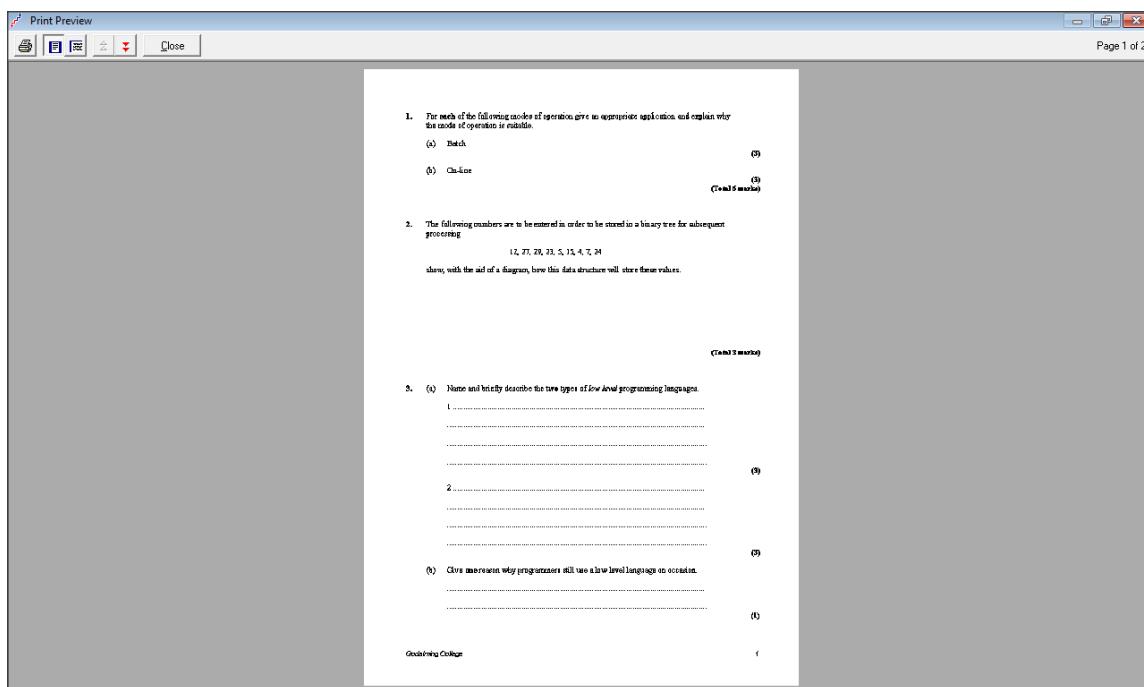
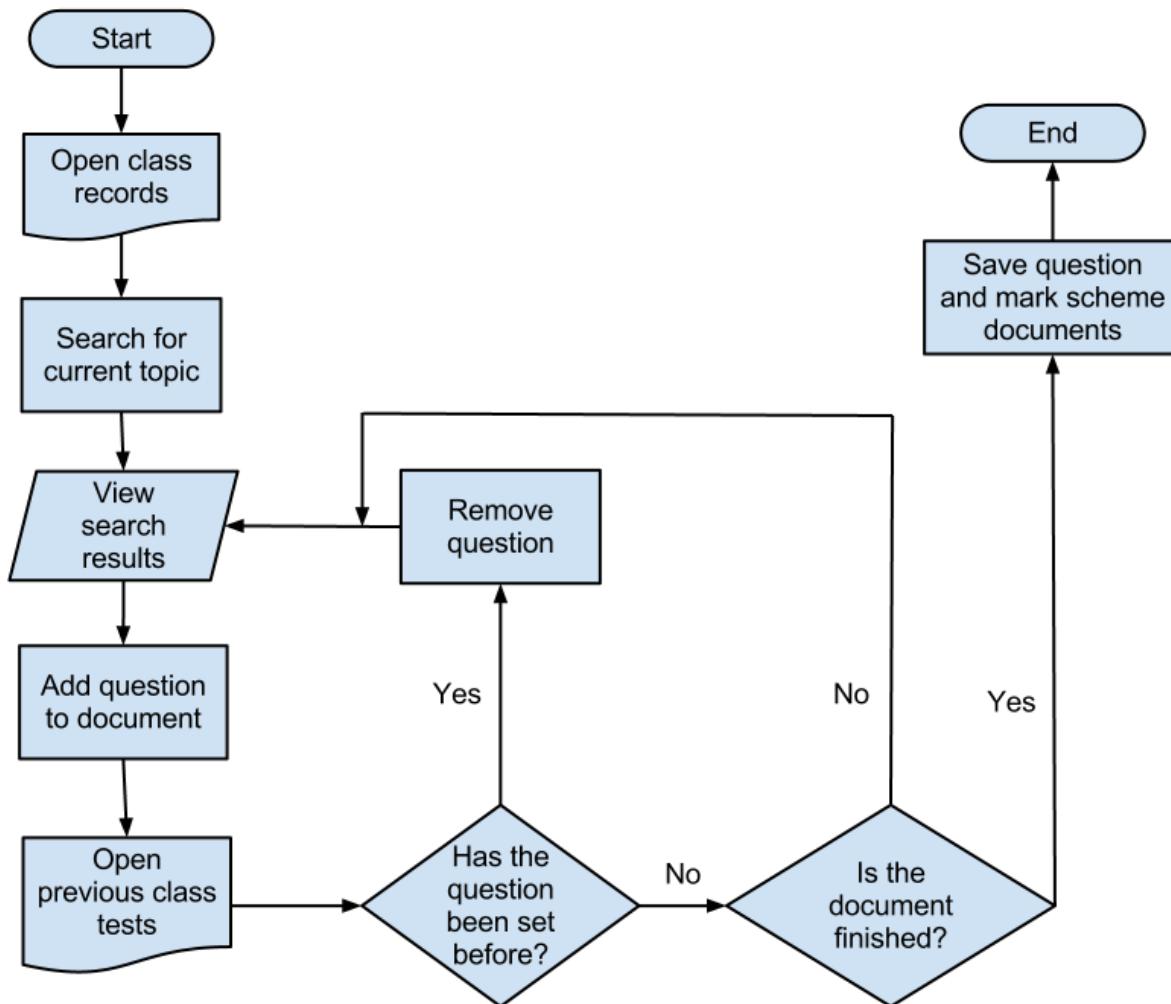


Figure 6

### 3. Questions are set

- 3.1. The questions are shown to the class on the interactive whiteboard. The students complete them on paper. Although the eventual scores will be saved, the papers are rarely kept. There is a student database integrated into the existing system though this is rarely used, if ever.
- 3.2. The students swap quizzes and the mark scheme is displayed so they can mark them.
- 3.3. Anne collects the answers in a spread sheet which contains every student's score for all quizzes set throughout the year. There is no way to normalize the scores in cases of particularly difficult topics or questions, so isn't always a true representation of the student's ability.

## System Flowchart



The flowchart models the system as it is now. This enables me to see the inefficient parts of the process - for example, the user has to check every time they add a question to a document that the question has not been added before.

## Prospective Users and Acceptable Limitations

At present, there would be at most three users of the system; the teachers in the physics department, with Anne Lancaster being the primary user. All of the teachers are computer literate to a level which means their skills shouldn't limit the complexity of the new system. Nevertheless, it is important for the staff to spend as little time as possible navigating the system so that it doesn't cut into lesson time, so ease-of-use is still an important factor.

Although the students aren't the primary clients, they will be directly affected by the questions produced by the system, so the question types should be of a similar format to those they are or will be familiar with from exam papers.

The limitations to the system are as follows:

- Hardware and software constraints - There is only a limited amount of hardware in the physics department for the teachers to use, and a limited amount of software available for me to design the new system. This rules out the use of mobile applications as not all teachers have smart phones or tablets.
- My skills and knowledge - The problem can't be too complex for me to be able to solve using the resources I have available. I'll be creating the solution in VB.NET and so could write the program in a number of different paradigms.
- Moodle constraints – Although complex question types and questions involving images or diagrams with labeling do feature in exam papers, I'm limited to using question types that Moodle can not only recognize and support but also automatically mark rather than send to a teacher for feedback.
- Time constraints - The system needs to be completed by Easter.

## Document Specification Sheets - Volumetrics and Data Dictionaries

The documents below are examples of those currently in different parts of the system and identify both common and format-specific data. This will allow me to identify the data and data types that will need to be included in the new system.

**Density Question Sheet.**
**DENSITY ①**

Data:

Material	<u>Density / kg m<sup>-3</sup></u>
Glass	2500
Aluminium	2700
Steel	7700
Gold	19300
<i>the densest element → Osmium</i>	22500
Balsa Wood	150
<i>at 0°C and 1 atmosphere → Air</i>	1.29
<i>at 100°C and 1 atmosphere → Air</i>	0.95
<i>at 4°C and 1 atmosphere → Water</i>	1000
<i>at 100°C and 1 atmosphere → Water</i>	958

 Volume of a cylinder  $\pi r^2 l$ 

 Volume of a sphere  $4 \pi r^3 / 3$ 

1. a. ③ A cube of edge 8 cm is made from balsa wood. Calculate its volume, and its mass.  
 b. ④ Calculate the mass of a similar cube made from osmium.  
 c. ⑤ Divide mass (b) by mass (a). What should this equal? Does it?  
 d. ⑥ A third similar cube has a mass of 1.28 kg. Calculate its density. From what might it be made?
2. ⑦ A steel rod of diameter 15 mm has a mass of 544 g. Calculate the length of the rod.
3. ⑧ The *nucleus* of an iron atom is spherical and has a radius of  $4.6 \times 10^{-15}$  m; the mass of the nucleus is  $9.5 \times 10^{-26}$  kg. Calculate the density of the nuclear material.
4. ⑨ One litre of water is heated from 4°C to 100°C at constant pressure. Calculate the new volume.
5. ⑩ A living room measures 4 m wide x 7 m long x 3 m high. *Estimate* the mass of air in the room on a warm day. (NB. Estimate means make as good an approximate calculation as you can, stating any assumptions you need to make.)

**⑬ EXTENSION QUESTIONS (Try these if you are happy you have understood the ones above)**

6. ⑪ A porous metal cube of side 100 mm is made from metal of density  $8000 \text{ kg m}^{-3}$  and has a mass of 7.2 kg. Calculate the volume of the pores in the metal, assuming you can ignore the mass of the trapped air.
7. ⑫ An alloy made from osmium and gold has a density of  $20200 \text{ kg m}^{-3}$ . Calculate the percentage by volume of gold in the alloy.

Volumetrics					
Document description	System		Document	Name	Sheet
Density Question Sheet	Physics department quizzes		Quiz	Density	1/1
Stationery ref.	Size		Number of parts	Method of preparation	
n/a	A4		1	Manually typed	
Filing sequence		Medium		Prepared by	
n/a		Digital		Anne Lancaster	
Frequency of preparation		Retention period		Location of file	
Once		Indefinite		Digital copy on the college network	
Volume	Minimum	Maximum	Ay/Abs	Growth rate/fluctuations	
	1 per lesson	1	1	No fluctuations	
Users/receipts		Purpose			Frequency of use
Anne Lancaster Physics students		Assigning questions Answering questions			Once Once
Data Dictionary					
Ref	Name	Data Type	Length	Occurrence	Source of data
1	Title	String	7	1	Teacher
2	Data	String	400	1	Teacher
3	Question 1a	String	80	1	Teacher
4	Question 1b	String	55	1	Teacher
5	Question 1c	String	60	1	Teacher
6	Question 1d	String	96	1	Teacher
7	Question 2	String	83	1	Teacher
8	Question 3	String	165	1	Teacher
9	Question 4	String	95	1	Teacher
10	Question 5	String	222	1	Teacher
11	Question 6	String	203	1	Teacher
12	Question 7	String	122	1	Teacher
13	Extensions	String	83	1	Teacher

Momentum Question Sheet.

## Momentum Questions ①

② 1. For the two physical quantities, impulse and force, which one of the following is correct?

- ③ A Impulse is a scalar and momentum is a scalar.
- ④ B Impulse is a scalar and force is a vector and momentum is a vector.
- ⑤ C Impulse is a vector and momentum is a vector and force is a scalar.
- ⑥ D impulse is a vector and force is a vector and momentum is a vector.

⑦ (Total 1 mark)

2. In a vehicle impact test, a car of mass 1200 kg travelling at a velocity of  $18 \text{ ms}^{-1}$  is stopped by a large concrete block. A force meter attached to the block is used to measure the average force of the impact. The force meter measured an average force of 240 kN. What was the duration of the impact?

- A 0.090 s
- B 0.18 s
- C 0.90 s
- D 1.8 s

(Total 1 mark)

3. Water of density  $1000 \text{ kg m}^{-3}$  flows out of a garden hose of cross-sectional area  $7.2 \times 10^{-4} \text{ m}^2$  at a rate of  $2.0 \times 10^{-4} \text{ m}^3$  per second. How much momentum is carried by the water leaving the hose per second?

- A  $5.6 \times 10^{-5} \text{ N s}$
- B  $5.6 \times 10^{-2} \text{ N s}$
- C 0.20 N s
- D 0.72 N s

(Total 1 mark)

Volumetrics					
Document description	System		Document	Name	Sheet
Momentum Question Sheet	Physics department quizzes		Quiz	Momentum Questions	1/1
Stationery ref.	Size		Number of parts	Method of preparation	
n/a	A4		1	Compiled in Exampro	
Filing sequence		Medium		Prepared by	
n/a		Digital		Anne Lancaster	
Frequency of preparation		Retention period		Location of file	
Once		Indefinite		Digital copy on the college network	
Volume	Minimum	Maximum	Av/Abs	Growth rate/fluctuations	
	1 per lesson	1	1	No fluctuations	
Users/receipts		Purpose			Frequency of use
Anne Lancaster Physics students		Assigning questions Answering questions			Once Once
Data Dictionary					
Ref	Name	Data Type	Length	Occurrence	Source of data
1	Title	String	18	1	Teacher
2	Question text	String	100-250	3	Exampro
3	Answer A	String	5-67	3	Exampro
4	Answer B	String	5-67	3	Exampro
5	Answer C	String	5-67	3	Exampro
6	Answer D	String	5-67	3	Exampro
7	Question mark	String	5-67	3	Exampro

## Particle Physics Moodle Questions.

Home ▶ 11-3;PHA ▶ Quizzes ▶ Particle Physics Student Quiz ▶ Attempt 1

**1** Particle Physics Student Quiz - Attempt 1

1 **2** Which of these are conserved?

Marks: -/1

Choose one answer.

a. Bosons **4**  
 b. Lepton number **5**  
 c. Meson Number **6**  
 d. speed before and after collision **7**

**3**

**Submit**

---

2 what are the 3 quarks that make up a proton

Marks: -/1

Choose one answer.

a. down up strange  
 b. up up down  
 c. down down up  
 d. up up strange

**Submit**

---

3 what are the three quarks we need to know?

Marks: -/1

Choose one answer.

a. Up, Down, Left.  
 b. Down, Right, Crazy  
 c. anti up, strange right, forwards.  
 d. Strange, Up, Down.

**Submit**

---

4 WHICH OF THE FOLLOWING ARE MESONS?

Marks: -/1

Choose one answer.

a. Neutrino, neutron, Pion  
 b. Neutrino, Kaon, Electron.  
 c. Pion, Kaon, Tau  
 d. Proton, Electron, Neutron.

**Submit**

Volumetrics					
Document description		System		Document	Name
Particle Physics Moodle Questions		Physics department quizzes		Quiz	Particle Physics Student Quiz
Stationery ref.		Size		Number of parts	Method of preparation
n/a		n/a (Web-based)		1	Manually typed into Moodle's question creator
Filing sequence			Medium		Prepared by
n/a			Digital		Anne Lancaster
Frequency of preparation			Retention period		Location of file
Once			Indefinite		College Moodle database
Volume	Minimum		Maximum	Av/Abs	Growth rate/fluctuations
	2 per term		5	3	Fluctuations: Jan/Feb and May/June exam sessions
Users/receipts		Purpose			Frequency of use
Anne Lancaster Physics students		Assigning questions Answering questions			Once Once
Data Dictionary					
Ref	Name	Data Type	Length	Occurrence	Source of data
1	Title	String	18	1	Teacher
2	Question text	String	100-250	4	Teacher
3	Mark	Integer	1	4	Teacher
4	Answer A	String	8-30	4	Teacher
5	Answer B	String	8-30	4	Teacher
6	Answer C	String	8-30	4	Teacher
7	Answer D	String	8-30	4	Teacher

## Refraction Mark Scheme.

**① Refraction Problems – Mark Scheme**

② 1. Calculate the refractive index for glass in which the speed of light is  $2.25 \times 10^8 \text{ ms}^{-1}$

$$\textcircled{3} \quad n = \frac{3.00 \times 10^8}{2.25 \times 10^8} = 1.33 \textcircled{5}$$

④ [1]

2. Calculate the speed of light in diamond whose refractive index is 2.42

$$v = \frac{3.00 \times 10^8}{2.42} = 1.24 \times 10^8 \text{ ms}^{-1}$$

[1]

3. Calculate the refractive index for paraffin in which the speed of light is  $2.08 \times 10^8 \text{ ms}^{-1}$

$$n = \frac{3.00 \times 10^8}{2.08 \times 10^8} = 1.44$$

[1]

4. Calculate the speed of light in perspex whose refractive index is 1.49

$$v = \frac{3.00 \times 10^8}{1.49} = 2.01 \times 10^8 \text{ ms}^{-1}$$

[1]

5. Calculate the refractive index for a medium given that the angle of incidence is  $30^\circ$  and the angle of refraction is  $24^\circ$ .

$$n = \frac{\sin 30^\circ}{\sin 24^\circ} = \frac{0.500}{0.407} = 1.23$$

[1]

6. Calculate the refractive index for glass if the angle of incidence is  $45^\circ$  and the angle of refraction is  $27^\circ$ .

$$n = \frac{\sin 45^\circ}{\sin 27^\circ} = \frac{0.707}{0.454} = 1.56$$

[1]

7. Calculate the angle of refraction in water if the angle of incidence in air is  $24^\circ$  and the refractive index is 1.33.

$$\frac{\sin r}{n} = \frac{\sin 24^\circ}{1.33} = \frac{0.407}{1.33} = 0.306 \rightarrow r = 17.8^\circ = 18^\circ$$

[1]

8. Calculate the angle of incidence in air if the angle of refraction is  $37^\circ$  and the refractive index of the material is 1.65.

$$\sin i = n \sin r = 1.65 \sin 37^\circ = 1.65 \times 0.602 = 0.993 \rightarrow i = 83.2^\circ \dots = 83^\circ$$

[1]

9. A ray passes from air to water, calculate the angle in air if the angle in water is  $45^\circ$

$$1.33 \sin 45 = 1.00 \sin \theta_{\text{air}} \rightarrow \sin \theta_{\text{air}} = 1.33 \times 0.707 = 0.940$$

$$\theta_{\text{air}} = 70^\circ$$

[1]

10 A ray passes from air to glass, calculate the angle in the glass if the angle in air is  $60^\circ$

$$1.00 \sin 60 = 1.50 \sin \theta_{\text{glass}} \rightarrow \sin \theta_{\text{glass}} = \frac{1.00 \times 0.866}{1.50} = 0.577$$

$$\theta_{\text{glass}} = 35^\circ$$

[1]

11. A ray passes from water to glass, calculate the angle in glass if the angle in water is  $55^\circ$

$$1.33 \sin 55 = 1.50 \sin \theta_{\text{glass}} \rightarrow \sin \theta_{\text{glass}} = \frac{1.33 \times 0.819}{1.50} = 0.726$$

$$\theta_{\text{glass}} = 46.578\dots^\circ = 47^\circ$$

[1]

12. A ray passes from glass into water. Calculate the angle in the glass if the angle in water is  $90^\circ$ . What is this angle called?

$$1.33 \sin 90 = 1.50 \sin \theta_{\text{glass}} \rightarrow \sin \theta_{\text{glass}} = \frac{1.33 \times 1.00}{1.50} = 0.887$$

$$\theta_{\text{glass}} = 62.457\dots^\circ = 62^\circ$$

[1]

Volumetrics					
Document description	System		Document	Name	Sheet
Refraction Mark Scheme	Physics department quizzes		Mark Scheme	Refraction Problems – Mark Scheme	1/7
Stationery ref.	Size		Number of parts	Method of preparation	
n/a	2 sides A4		1	Compiled in Exampro	
Filing sequence		Medium		Prepared by	
n/a		Digital		Anne Lancaster	
Frequency of preparation		Retention period		Location of file	
Once		Indefinite		Digital copy on the college network	
Volume	Minimum	Maximum	Av/Abs	Growth rate/fluctuations	
	1 per quiz per lesson	1	1	No Fluctuations	
Users/receipts		Purpose			Frequency of use
Anne Lancaster Physics students		Assigning questions Answering questions			Once Once
Data Dictionary					
Ref	Name	Data Type	Length	Occurrence	Source of data
1	Title	String	31	1	Exampro
2	Question text	String	100-250	12	Exampro
3	Calculation	String	200-500	12	Teacher
4	Mark	Integer	1	12	Exampro
5	Answer	Integer		12	Exampro

## Teacher's Mark Book.

Volumetrics						
Document description	System		Document	Name		Sheet
Teacher's mark book	Physics department quizzes		Mark book page	Mechanics (marks)		1/1
Stationery ref.	Size		Number of parts	Method of preparation		
n/a	1 side A4		1	Filled in by the physics teacher after every text/quiz		
Filing sequence		Medium		Prepared by		
n/a		Manual		Anne Lancaster		
Frequency of preparation		Retention period		Location of file		
Every lesson		Indefinite		Teacher's mark book, kept in physics dept.		
Volume	Minimum		Maximum	Av/Abs	Growth rate/fluctuations	
	1 column per lesson		1	1	No Fluctuations	
Users/receipts		Purpose			Frequency of use	
Anne Lancaster		Recording students' marks Checking the most recent topic covered Referring to marks when writing reports etc.			Once Once Up to 3 times/year	
Data Dictionary						
Ref	Name	Data Type	Length	Occurrence	Source of data	
1	Unit code	String	4	1	Timetable codes	
2	Group name	String	2	1	Timetable codes	
3	Topic title	String	9	1	Teacher/Specification	
4	Individual lesson columns	String	4-10	9	Teacher	
5	Lesson dates	Date	8	9	Teacher	
6	Students' names	String	10-30	20	Teacher/Register	
7	Individual scores/grades	String	1-2	180	Teacher	

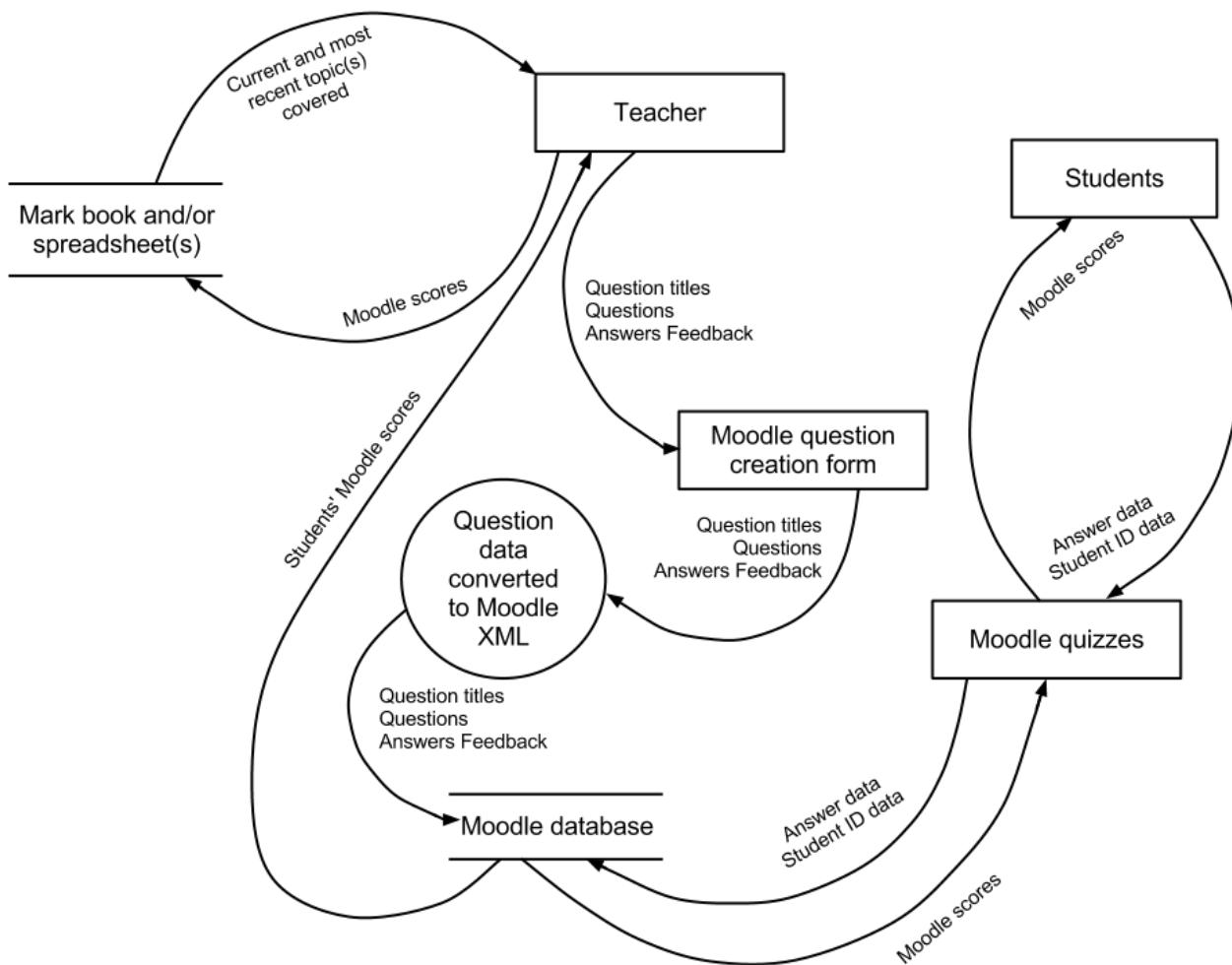
## Data Sources and Destinations

In the Existing System		
What is it?	Source	Destination
Paper-based question	Exampro database	Printed and given to students
Online Question	Created by the teacher	Stored in the Moodle database
Paper-based mark scheme	Exampro database	Printed and given to students
Online mark scheme	Created by the teacher	Stored in the Moodle database
Current topic details	Noted by the teacher	Teacher's records
Students' scores	Quiz marks/Moodle database	Teacher's records

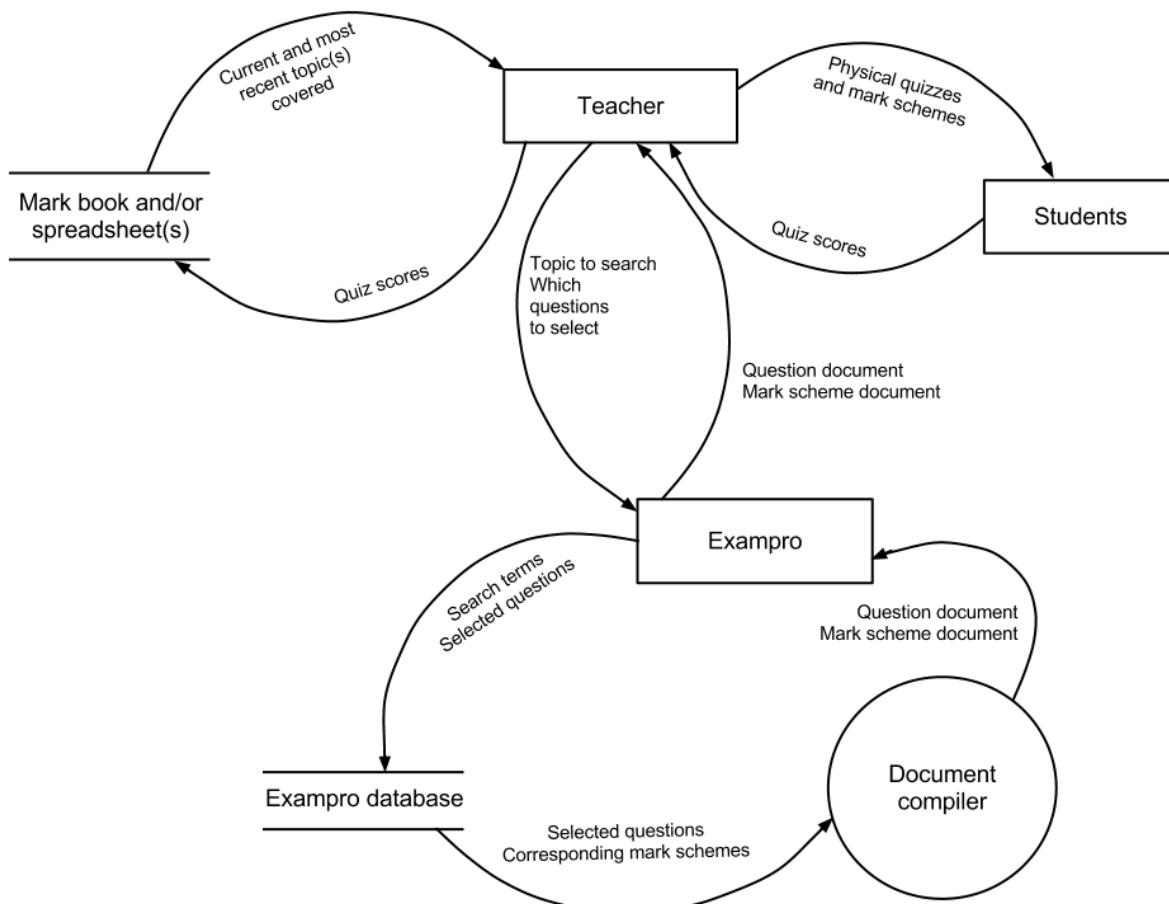
In the Proposed System		
What is it?	Source	Destination
Paper-based question	Created by the teacher	Printed and given to students
Online Question	Created by the teacher	Converted by the system and saved on the network to be uploaded to Moodle
Paper-based mark scheme	Created by the teacher	Printed and given to students
Online mark scheme	Created by the teacher	Converted by the system and saved on the network to be uploaded to Moodle
Current topic details	Noted by the teacher	Stored in a log on the system
Students' scores	Quiz marks/Moodle database	Teacher's records
Question difficulty ratings	Created by the teacher	Stored in the database and/or printed with the mark scheme(s)

## Data Flow Diagrams

Between the Teacher, Students and Moodle.

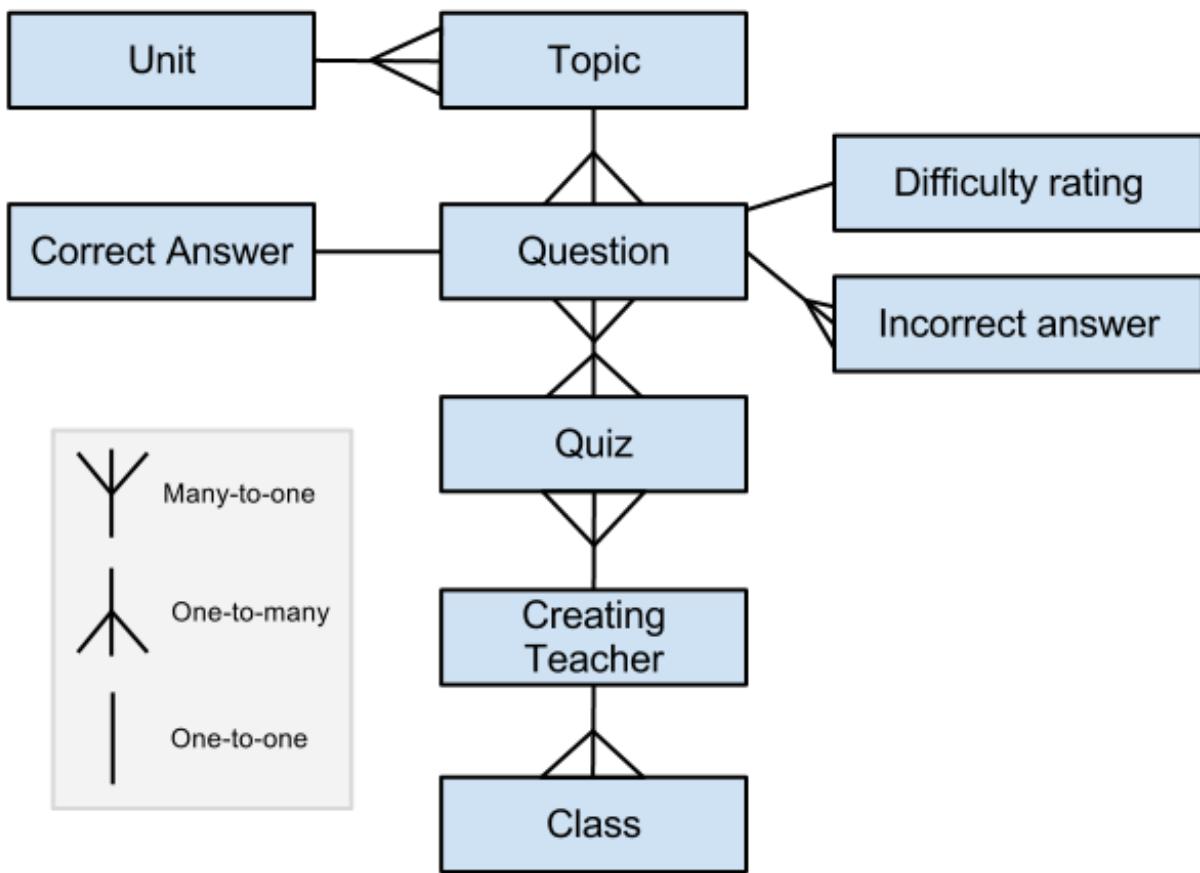


Between the Teacher, Students and Exampro.



Both the data sources and destinations tables and the data flow diagrams illustrate the processes and flow of data in the current system between the teacher, the Exampro question database, the teacher's records, and the students. They are essentially both data models of the observation I conducted of the teachers using the system, and allow me to see which parts of the system use which types of data and track its path.

## Entity Relationship Diagram



If I choose to solve the problem using a database, the diagram above identifies the relationships between the entities in the system. A question has one topic, one rating, one correct answer, and many incorrect answers. It can belong to many quizzes, and a quiz contains many questions. A topic has many questions but only one unit, and a unit has many topics.

## Tasks to be Computerised and the Benefits of Computerising

- Allowing questions to be exported in a format accepted by Moodle
- Allowing all questions to be searchable by type, difficulty, etc.
- Providing templates for teachers to create quizzes and save questions to be stored
- Allowing the user to keep a record within the system of the most recent topics covered by each class
- Allowing the user to assign questions a difficulty rating in order to normalise scores when marking

### Qualitative Benefits:

- A more user-friendly interface
- Questions won't have to be typed out manually to export Moodle
- Greater flexibility of the types of questions that can be set
- Complete flexibility of the questions themselves
- Each record can be stored separately, allowing for a changing number of classes

### Quantitative Benefits:

- A potentially unlimited number of questions can be stored in the system
- A potentially unlimited number of classes can be recorded

## Objectives for the Proposed System

I have learned a lot about the existing system both from the staff observations and by using the software myself. I was able to observe features which worked well, features that were unnecessary for the users' needs and features which the system lacked altogether.

1. The system must be able to store all the relevant details about every question entered:
2. Question, answer, unit, topics and type should be mandatory for each entry.
3. For multiple choice questions, the incorrect answers should also be stored.
4. There should be a default difficulty rating for each question (out of five) which can be edited or left as the default.
5. There should be different question types available similar to the types that feature in the exams – short answer, calculation, etc.
6. The questions must be searchable and displayable by question type, unit, topic, and difficulty rating.
7. Users must be able to search all questions for a specific string.
8. Searching questions should involve the minimum free text entry to save time and minimise errors. This could be implemented using radio buttons or drop-down menus for selection.
9. The user must be able to edit existing questions or delete them from the database.
10. The user should be able to preview the answer to each question that is displayed.
11. The user must be able to add records of new classes to the system.
12. Each class stored must have its own 'log' which would allow free text entry similar to a teacher's diary. The user must be able to record recently set questions from the textbook or chapters covered and retrieve this information when assigning new questions.
13. The user must be able to delete classes or class logs from the system.
14. The user should be able to create a quiz by selecting questions from the database and/or adding new questions.
15. The system must notify the user if they are adding a question to a quiz which already contains it to prevent unnecessary duplicates.
16. The user should be able to export text-based quizzes as text files to be emailed or printed.
17. Text-based quizzes should have separate numbered mark schemes unlike the integrated Moodle quizzes.
18. The system should be able to export quizzes with integrated answers in a format and the UTF-8 encoding recognised by Moodle.
19. Users should be able to see at all times a 'count' of how many questions they are viewing and how many are in the current quiz.
20. The system must include button shortcuts for common actions such as adding and removing questions to or from quizzes in order to reduce the time spent navigating menus.

## Potential Solutions and Justification of Chosen Solution

Potential Solutions:

1. A manual system, which would allow teachers complete flexibility with their questions as they could simply word-process them using a template created by the system. Any question type supported by Moodle could be saved, and teachers would have greater control over the formatting of the text-based quizzes and mark schemes. Questions could then be copied and pasted into the Moodle question creator form to allow students to access them online.
  - Although more than feasible in terms of my available resources and time-frame, this solution is unfeasible in terms of development.
  - This is primarily because it only makes one improvement on the existing system, while removing the features that the client found most useful, such as being able to search for particular questions by type and unit.
  - All questions and additional data would have to be manually entered which would involve a lot of unnecessary repetition of entry for fields such as units and topics. This could also lead to typographic errors.
  - A manual system would be much more time-consuming on a day-to-day basis, wasting lesson time. This is especially important to consider given that these quizzes are often set as starter activities and therefore the process of generating them must be quick and easy.
  - The process of copying and pasting individual questions and answers into the Moodle creator form would be repetitive and a waste of time for the staff; it's a far less complicated process to upload a text file with parsed questions and answers in bulk into the online question bank and let Moodle import and format them automatically.
2. A system which is part-manual and part-computerised. The questions would be entered with the answers and other relevant and stored in the system in a database or text file(s) and the user would be able to use an improved search filter to filter the questions by unit, topic, difficulty rating or type. This would then allow them to copy and paste questions of their choosing into a text file or similar in order to be saved and used as a text-based quiz or (with certain formatting) uploaded to Moodle.
  - This solution is too close to the existing system and doesn't match the needs of the client. It would be feasible both in terms of development and my abilities, but it would merely be an improvement as opposed to a solution.
  - The improvements from the previous solution would be the ability to select repetitive data such as units, topics and rating from drop-down lists rather than having to manually enter them every time and risk typographic errors.
  - In order for copied and pasted questions to be saved in text files by the user and uploaded to Moodle, the user would have to individually go through each

question and add the relevant formatting (GIFT or Moodle XML) and then save it using the correct encoding. Even the simplest of errors such as not closing an XML tag or forgetting a tilde can cause questions to be imported incorrectly, and the entire document to become useless.

- Other drawbacks are the same as with the previous solution; it would still be a time-consuming process to have to manually copy data out of the system, even if the inputs, processing and storage were fully computerised.
3. A fully computerised and part web-based system which would eliminate the need for questions to be stored on Moodle at all. Students would be able to login through the college network and answer any questions the teacher had assigned. Their scores would be stored in the database for the teacher to review and provide e-mail feedback.
- This solution isn't feasible in terms of my time constraints and abilities, and it doesn't meet the user's needs. It would take too long to design and I would need access to the College's username and password data, which compromises network security.
  - The end user wanted questions to be stored on Moodle and saved/printed, and this solution wouldn't facilitate that, meaning it meets few of the objectives for the proposed system, and is vastly over-complicated.
  - The pupils would need computers to be able to answer the questions as a starter activity in the lesson which is impractical, and both students and staff would have to adjust to a new learning environment, which is unnecessary as Moodle facilitates all of the client's initially outlined needs.

Chosen Solution:

4. A fully-computerised system which could potentially meet all of the objectives and remove all of the time-consuming manual processes from the system. Questions would be entered by the user and stored with either in a database or text file(s), along with other relevant data which would allow them to be filtered and displayed by various parameters. Quizzes could be created and then either saved or exported to Moodle, along with a separate answer sheet (for printed quizzes) or integrated answers (for Moodle.)
  - As long as all the objectives prove to be realistic and achievable, this is the most feasible potential solution. It meets the user's needs as outlined by the objectives for the proposed system and it could be updated as time progresses to deal with changing classes or styles of question.
  - The existing staff shouldn't have a problem using the system skill-wise, which means I can make it as efficient as possible without having to keep the interface at the most basic of complexity levels.
  - This solution should be achievable when taking into account my skill level and the time constraints.
  - The students wouldn't have to adjust to a new system of taking quizzes and so could concentrate more on their work.
  - Data which would be constantly repeated such as module names could, as above, be stored by the system for quick selection to minimise time spent using the system and the possibility of typographic errors.
  - Using forms to control the user's input rather than importing questions from text files means that features such as allowing the user to insert commonly used Unicode characters used in physics such as letters of the Greek alphabet and mathematical symbols can be included with relatively no difficulty.
  - The user wouldn't have to copy and paste anything from the system or system files to other documents, because the exporting of Moodle quizzes and text-based quizzes and mark schemes would be done quickly and automatically.

# Design

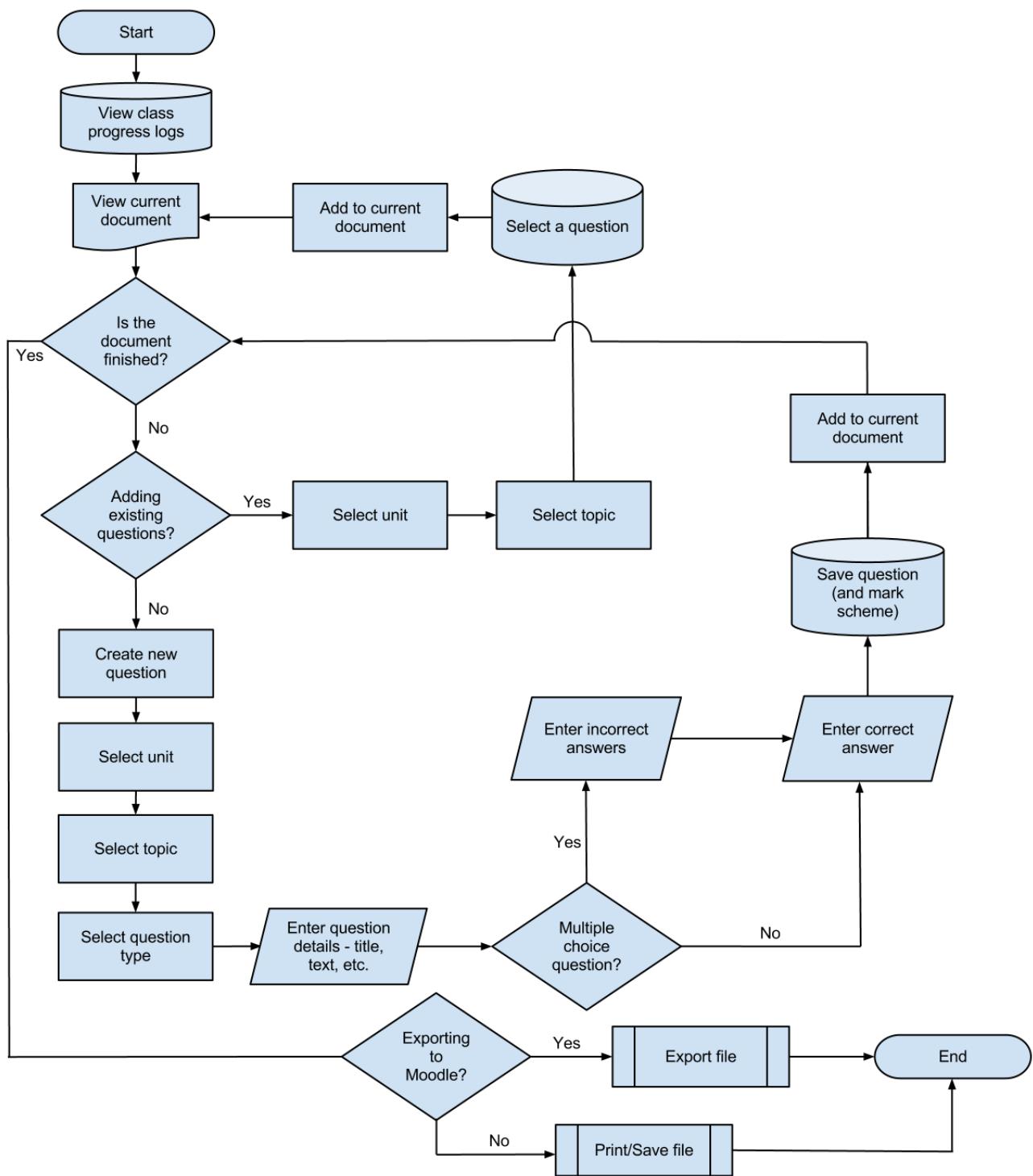
## IOPS Chart

This chart outlines what happens to the data in the new system at the most basic level, in terms of input/output, processing, and storage.

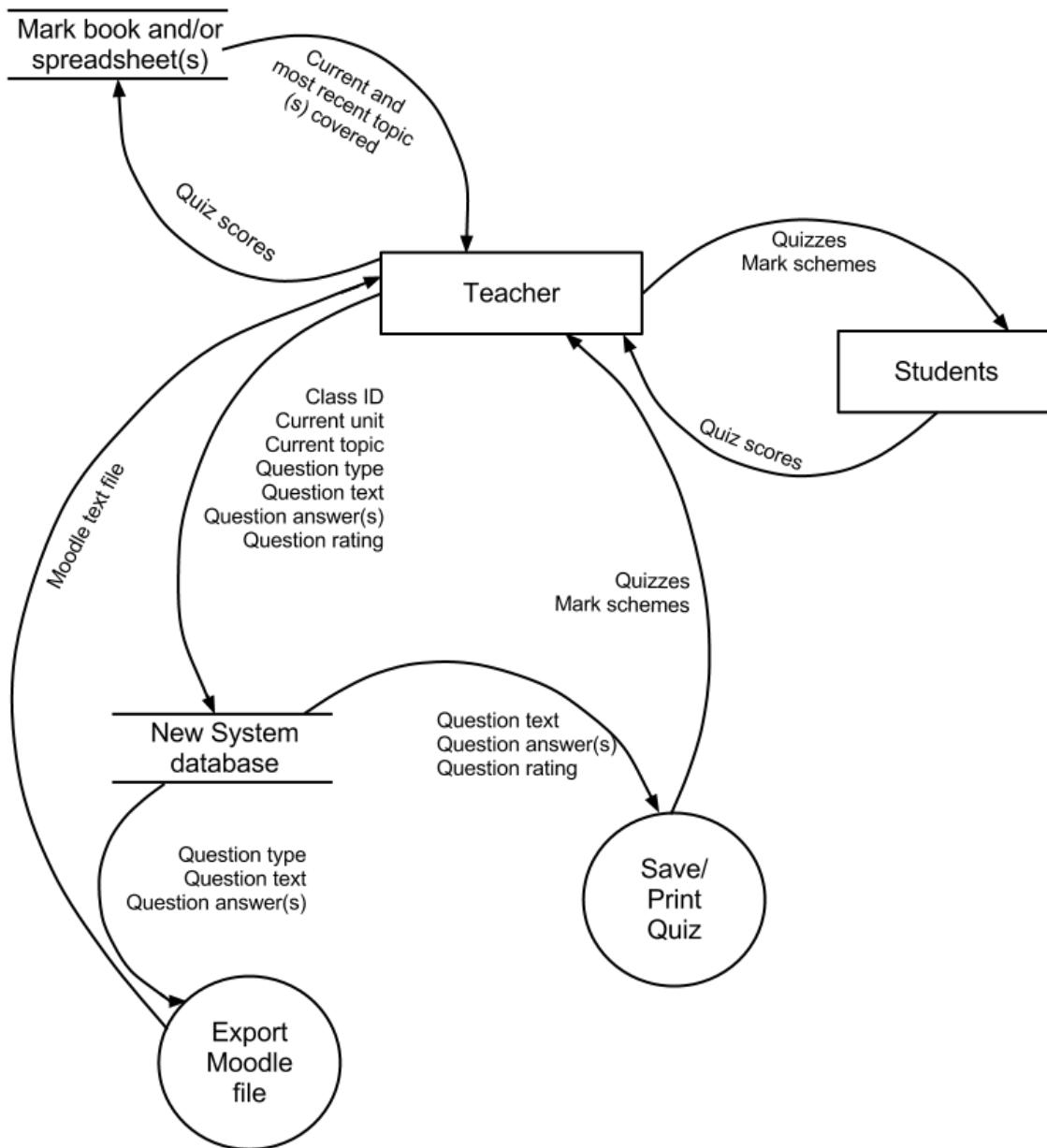
<i>Input</i>	<i>Process</i>
<ul style="list-style-type: none"> <li>● Class ID</li> <li>● Class name</li> <li>● Class record (recent topics)</li> <li>● Unit of work</li> <li>● Topics</li> <li>● Question type</li> <li>● Question text</li> <li>● Correct answer</li> <li>● Incorrect answers (if multiple choice)</li> <li>● Saved quiz name (when loading)</li> <li>● File name (when saving)</li> </ul>	<ul style="list-style-type: none"> <li>● Retrieve and display questions from database/list</li> <li>● Save questions to database/list</li> <li>● Save question documents</li> <li>● Load question documents</li> <li>● Convert questions in Moodle .gift format</li> <li>● Filter questions by unit, topic etc.</li> <li>● Print questions</li> </ul>
<i>Storage</i>	<i>Output</i>
<ul style="list-style-type: none"> <li>● Question database or list</li> <li>● Class database or list</li> </ul>	<ul style="list-style-type: none"> <li>● Moodle GIFT file</li> <li>● Digital question document</li> <li>● Printed question document</li> </ul>

## System Flowchart

The following chart is an update of the current system flowchart, outlining how the new system should operate. It looks to be more complex than the previous version, but most of the processes involved will be automated or at least easier to facilitate than the manual and time-consuming processes in the old system.



## Data Flow Diagram



The main difference between the data flow in the new and old systems is that the two previously separate flows (teacher-students-Moodle) and (teacher-students-Exampro) have been combined into one system. The current topics each class have can also be stored in the system for convenience. The interactions and flow of data between the teachers and students remain the same, because Anne and the other teachers felt this was a part of the system that didn't need to change.

## Data Dictionary and Validation

The following table contains all the data that could be entered into the system by the user, and how I plan to validate it to ensure that all fields are correctly inputted and stored. The erroneous data for most fields is a blank field, so in cases where the validation check is only allowing the user to select correct fields from a list or directory, there is no way to test this.

Field	Data Type	Length	Validation Check	Validation Description	Valid Data	Erroneous Data
Saved Quiz name (when loading)	String	1-30 characters	Lookup	Allows the user to select from only existing files.	(An existing file)	(A file which does not exist)
File name (when saving)	String	1-30 characters	Presence, length	File must have a name, and it must be 30 characters or less.	Refraction-Questions	(Blank)
Class Name	String	2 characters	List (when selecting) Length (when adding)	Allows the selection of an existing class or a class name of the correct length.	A1 (or an existing class)	A2345 (or class which does not exist)
Question text	String	1-500 characters	Presence	Question must exist.	What is mass measured in?	(Blank)
Question type	String	1-15 characters	List	Allows the user to choose one of the four existing types.	Multiple choice	(Blank or type which does not exist)
Correct answer	String	1-100 characters	Presence	Correct answer must exist.	10N	(Blank)

Field	Data Type	Length	Validation Check	Validation Description	Valid Data	Erroneous Data
Incorrect answer (multiple choice only)	String	1-100 characters	Presence	Incorrect answer must exist.	20N	(Blank)
Unit	Integer	5 characters	List	Allows selection from a list of all units.	PHYA1	(Blank)
General topic	String	1-50 characters	List	Allows selection from a list of all topics.	Physics of the ear	(Blank)
Specific topic	String	10-100 characters	List	Allows selection from a list of all topics.	Diffraction gratings	(Blank)
Rating	Integer	1 character	List	Allows selection from the integers 1-5.	4	(Blank)
Quiz title	String	1-30 characters	Presence	Quiz title must exist.	Stationary waves questions	(Blank)
Class record (most recent topics)	String	1-500 characters	Presence	Class record must exist.	Covered diffraction gratings on 10/9.	(Blank)

## Justification of Included Question types

Below are all the types of question that Moodle can recognise (as this will limit the types that the system can process) and my justification for including or not including them in the design of the new system. I've chosen them at an early stage because the layouts of the question types need to be factored into some of the early design processes.

Type	To be included?	Reasoning
Multiple choice	Yes	They're a common format of exam question, and aren't too time consuming for starter questions.
True/False	No	Although not a type of exam question, these can be answered quickly and can be used as 'filler' questions.
Short Answer	Yes	They're one of the most common types of exam question and can be applied to every topic.
Matching	No	Matching questions can't be applied to every topic, and are a very rare exam format.
Missing word	No	A large amount of text has to be entered and stored, which is time consuming and less efficient than other question types. The format also isn't used in exam questions at all.
Numerical	Yes	Calculation questions are another common exam format, and feature in every topic.
Description	No	If uploaded to Moodle, these cannot be automatically marked.
Essay	No	If uploaded to Moodle, these cannot be automatically marked.

## Stepwise Refinement

This is a more detailed list of the processes involved in the new system, mirroring the system flow chart. It allows me to break down each task into its simplest processes, and organise the data that has been inputted to store.

1. Check the current topic the class is covering
  - 1.1. Open the class records
  - 1.2. Choose the class to display
    - 1.2.1. Select class ID from the list
  - 1.3. Check the most recent topic
2. **If SELECTING EXISTING question(s)**
  - 2.1. Filter questions
    - 2.1.1. Search by unit, topic, difficulty rating or class
      - 2.1.1.1. Select options from given dialogue boxes
  - 2.2. Select questions to add
    - 2.2.1. Choose question
    - 2.2.2. (If question is already in the quiz, a warning is displayed)
2. **If ADDING NEW question(s)**
  - 2.1. Choose 'Create'
  - 2.2. Add question type
    - 2.2.1. Select question type from the list
  - 2.3. Enter the body text of the question
- 2.4. **If MULTIPLE CHOICE**
  - 2.4.1. Enter first, second and third incorrect answers
  - 2.4.2. Enter correct answer
  - 2.4.3. Enter feedback
  - 2.4.4. Enter difficulty rating
- 2.4. **If TRUE/FALSE**
  - 2.4.1. Indicate the correct answer
    - 2.4.1.1. Tick 'True' or 'False'
  - 2.4.2. Enter feedback
  - 2.4.3. Enter difficulty rating
- 2.4. **If SHORT ANSWER or NUMERICAL**
  - 2.4.1. Enter correct answer
  - 2.4.2. Enter feedback
  - 2.4.3. Enter difficulty rating
3. Choose whether to export a text-based quiz or a Moodle quiz
  - 3.4. Enter file name
  - 3.5. Save file
4. Update class logs

## Database Normalisation and Design

If I choose to base the new system around a database, this needs to be normalised to avoid inconsistencies from the duplication of data, and to save space by eliminating non-atomic data.

**Bold** indicates a primary (or in the case where more than one attribute in the same table is bolded, composite) key.

*Italics* indicate a foreign key, meaning that the attribute is the primary or partial-composite key in a different table.

This is the first table, before any attempt at normalisation.

tblquestion

<b>QID</b>	QText	Unit	QType	QAns	IncAns	Rating	GTopic	STopic	Class	Quiz

The table contains non-atomic data – attributes with repeated entries; in this case, IncAns, Class and Quiz – which are not only a waste of space but can also lead to users not being able to store all the relevant data. These need to be moved to new tables.

These are the tables in First Normal Form.

tblquestion

<b><i>QID</i></b>	<b>QText</b>	<b>Unit</b>	<b>QType</b>	<b>QAns</b>	<b>Rating</b>	<b>GTopic</b>	<b>STopic</b>

tblclassquestion

<b><i>QID</i></b>	<b>Class</b>

tblincorrectanswer

<b><i>QID</i></b>	<b>IncAns</b>

tblquiz

<b>QUIZID</b>	<b><i>QID</i></b>

In 1NF, none of the data is non-atomic. All three of the new tables require composite keys, because they both represent many-to-many relationships. You couldn't tell which class had been assigned a question just from the question ID, and you couldn't tell which question a class had been assigned just from the class name. Similarly with the table of incorrect answers, you couldn't tell which question an answer related to just from the answer itself, and you couldn't tell which incorrect answer was being stored just from the question ID. The same is true for quizzes and the questions they contain.

In the tblquestion, there are attributes that don't depend on the primary key. QUnit is dependant both on GTopic and STopic (unit and general topic have a one-to-many relationship, as do general topic and specific topic.) By knowing STopic, GTopic and Unit are automatically known, so in the questions table, only STopic needs to be stored. GTopic and Unit can be stored in separate tables because they are functionally dependant on STopic, and not QID.

These are the tables in Second Normal Form. As there are no functional dependencies existing between attributes that couldn't be used as alternatives to primary keys, the tables are also in 3NF at this point.

**tblquestion**

<b><i>QID</i></b>	<b>QText</b>	<b><i>STopic</i></b>	<b>QAns</b>	<b>Rating</b>	<b>QType</b>

**tblclassquestion**

<b><i>QID</i></b>	<b>Class</b>

**tblincorrectanswer**

<b><i>QID</i></b>	<b>IncAns</b>

**tblunittopic**

<b><i>GTopic</i></b>	<b>Unit</b>

**tbltopics**

<b><i>STopic</i></b>	<b><i>GTopic</i></b>

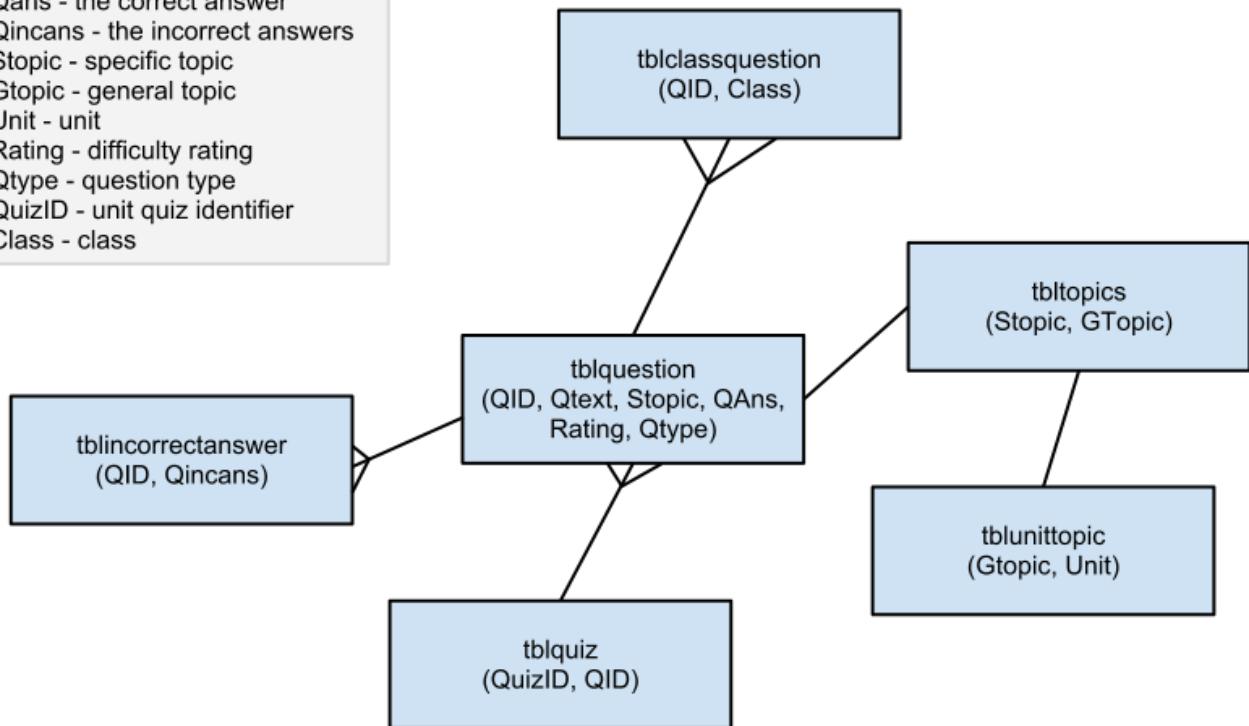
**tblquiz**

<b><i>QUIZID</i></b>	<b><i>QID</i></b>

## Table Relationship Diagram

This diagram illustrates the relationships between the normalised tables in the new system. The entity abbreviations are explained in the key. We can tell the data has been normalised because there are no many-to-many relationships.

QID - unique question identifier  
 Qtext - the body of the question  
 Qans - the correct answer  
 Qincans - the incorrect answers  
 Stopic - specific topic  
 Gtopic - general topic  
 Unit - unit  
 Rating - difficulty rating  
 Qtype - question type  
 QuizID - unit quiz identifier  
 Class - class



## Sample of Possible SQL Queries

**Displaying all existing questions in the database**

```
SELECT Qtext, Qtype, Rating FROM tblquestion
```

**Displaying all questions from a topic**

```
SELECT Qtext, Qtype, Rating  
FROM tblquestion  
WHERE Topic=?
```

**Displaying all questions of particular rating**

```
SELECT Qtext, Qtype, Rating  
FROM tblquestion  
WHERE Rating=?
```

**Displaying all questions of particular type**

```
SELECT Qtext, Qtype, Rating  
FROM tblquestion  
WHERE Type=?
```

**Adding a new question to the database**

```
INSERT INTO tblquestion(QID, Qtext, STopic, QAns, Rating, QTtype)  
VALUES(?, ?, ?, ?, ?, ?, ?)
```

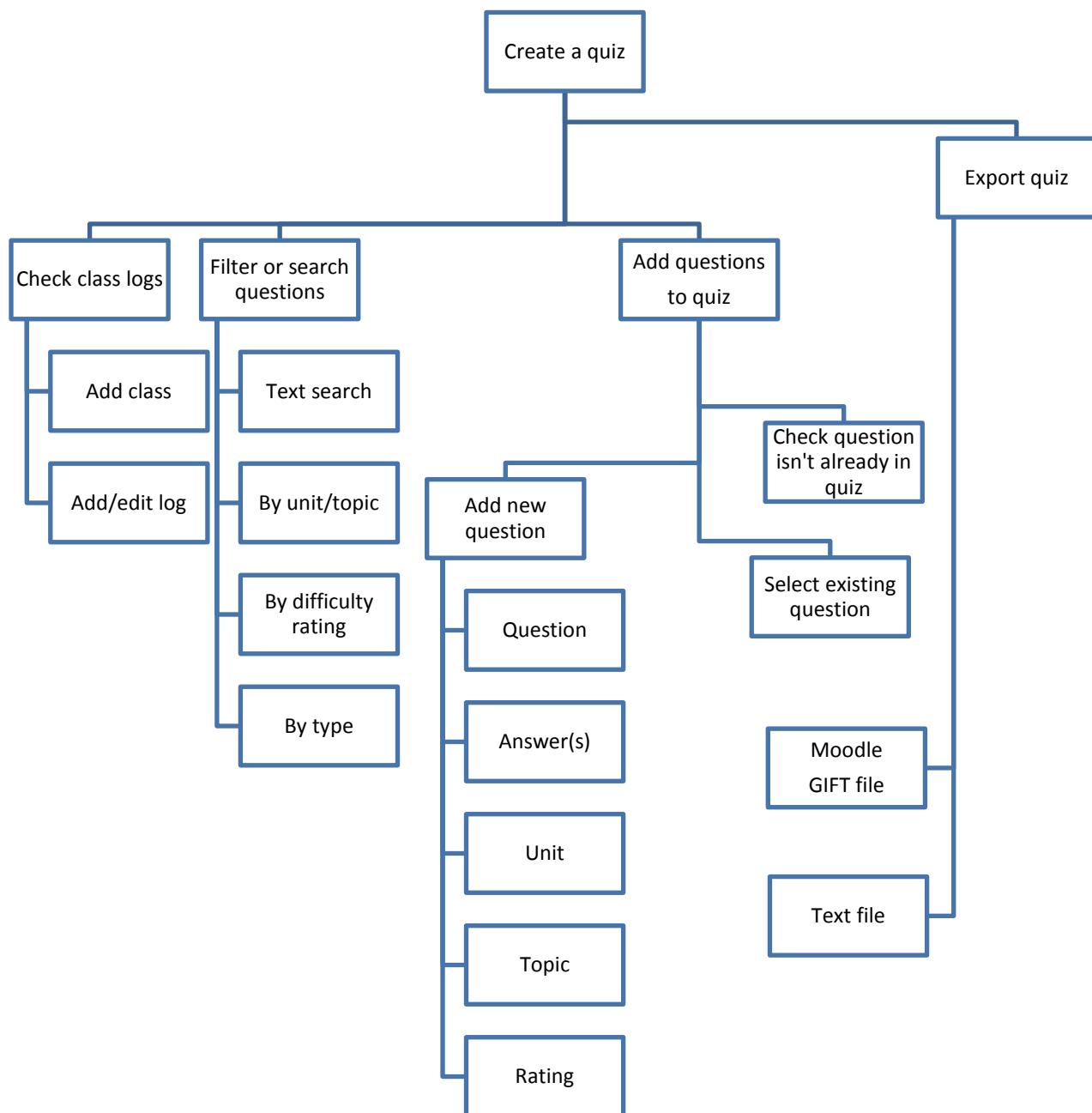
**Updating an existing question**

```
UPDATE tblquestion  
SET (changes)  
WHERE QID=?
```

**Deleting a question**

```
DELETE FROM tblquestion  
WHERE QID=?
```

## Top-Down Design



## OOP Class Design

These are the classes my system would use if I wrote in the OOP paradigm, modelling questions and groups as objects. Each question or class would be created at runtime when declared by the user. Quizzes could be modelled as objects that contain questions, but my software doesn't need to store quizzes past run-time, so for the purpose of exporting, quizzes would just be modelled as 2-dimensional arrays of question data.

### Class: Question

QID as integer (Question identifier)  
QText as string (The body of the question)  
QAns as string (The correct answer)  
QIncorrect(2) as string (Incorrect answers)  
QRating as integer (Difficulty rating)  
QTopic as string (Topic)  
QUnit as string (Unit)  
QType as string (Type)

### Class: Group

Name as string (Group name)  
Log as string (Record of current topic)

## Definition of Record Structure

I've chosen the Gift file format for converted Moodle questions because of the three supported types – the other two of which are Moodle XML and Moodle XHTML – it has the simplest syntax which should reduce errors when parsing text and also minimise file sizes. It also makes the converted questions more readable because there are no html tags or indented line breaks. Gift files have to be exported in UTF-8 variable-width encoding, but this is the default encoding for VB.NET's StreamWriter and therefore won't have to be changed.

Quizzes and mark schemes will be saved as .txt files – as they are only used once, formatting is not of great concern.

Because the data stored about each question is minimal – evidenced by the number of two column tables in the normalised database planning – and won't have to be changed or updated (either for Moodle or for printing and manually marking), I've decided to store the question list in a text file instead of a database. This means that time will be saved, because search algorithms can be used on the loaded list instead of more time-consuming SQL queries to a database that could be on an externally hosted server rather than the college network.

## Security and Integrity of Data

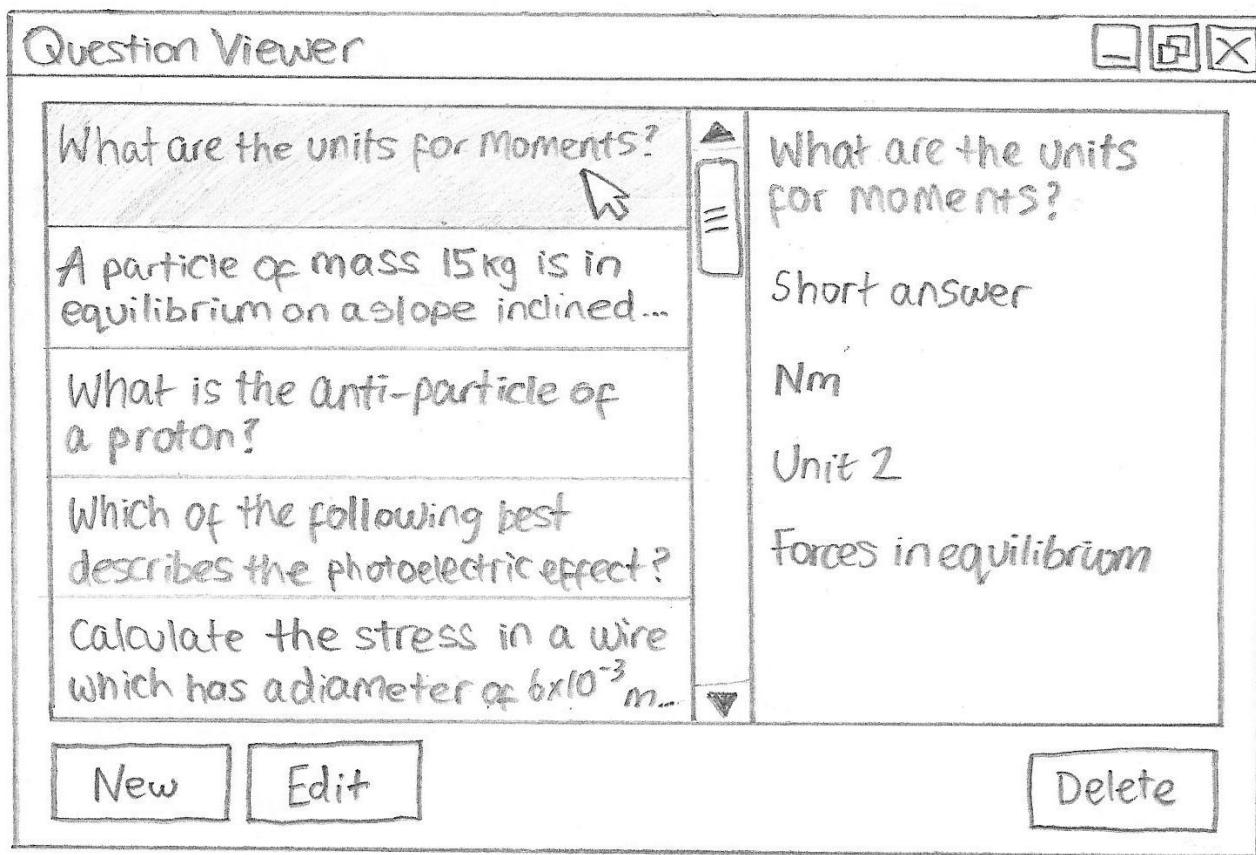
As there is no personal data stored about students or staff within the system, there is no need for any kind of encryption. Students won't have access to the system as it would only be installed on staff user areas, so having a restricted access profile is similarly not a concern. Storing the question and class data in text files rather than an externally hosted database means there is less chance a student could gain access to any answers.

To protect the integrity of the stored data, all data entry will be controlled by strict validation rules. Wherever possible – selecting question types, true/false answers, or filtering questions by certain parameters – the user will select their options from drop-down menus, radio buttons or tree diagrams. This minimises free text input which, as well as saving time, also stops typographic errors which may cause the system to crash or incorrect data to be stored.

## User Interface Design

Initial Drawings:

These drawings are my first outlines of what the interface of the system should look like. They will most likely not be the final designs, but they are the first generation of each form and a starting point for later concepts.



The 'Question Viewer' is the pane in which all existing questions in the system can be displayed. From within this pane, questions can be added, edited, or deleted. When search queries are specified, the question list will be filtered to ensure that the user only sees the relevant questions. Selecting a question on the left of the panel displays its unit, topic, type and answer(s) on the right of the pane.

**Add New Question**

Unit	2	<input checked="" type="checkbox"/>	X	
Topic	Forces in Equilibrium <input checked="" type="checkbox"/>			
Question	<input type="text"/>			
Type	<input checked="" type="radio"/> Short answer <input type="radio"/> Numerical <input type="radio"/> Multiple choice <input checked="" type="radio"/> True / False			
Answer	<input type="text"/>			
Rating	1	<input checked="" type="checkbox"/>	2	<input checked="" type="checkbox"/>
<b>Save</b>				

The diagram illustrates the 'Add/Edit Question' pane. It shows a main form with fields for Unit (2), Topic (Forces in Equilibrium), and a large empty text area for the question. Below these, a 'Type' section includes radio buttons for Short answer, Numerical, Multiple choice, and True / False. The 'Short answer' and 'Numerical' types share a layout with a text input field and a dropdown for rating (1 or 2). The 'True / False' type has a dropdown for rating (1 or 2) instead of a text input. The 'Multiple choice' type is shown separately on the right, featuring four additional text input fields labeled 'Wrong' and 'wrong' (each with a dropdown for rating 1 or 2).

This is the 'Add/Edit Question' pane. The user inputs all the data for a question including the question itself, unit and topic, and then the type. When the radio button for any type is clicked, the bottom of the pane will change to display the relevant answer inputs. Short answer and numerical answer are identical, with a text field for entry and a drop-down menu to select difficulty rating. True/False questions have another drop-down menu instead of a text field, and multiple choice questions have an additional four incorrect answer boxes.

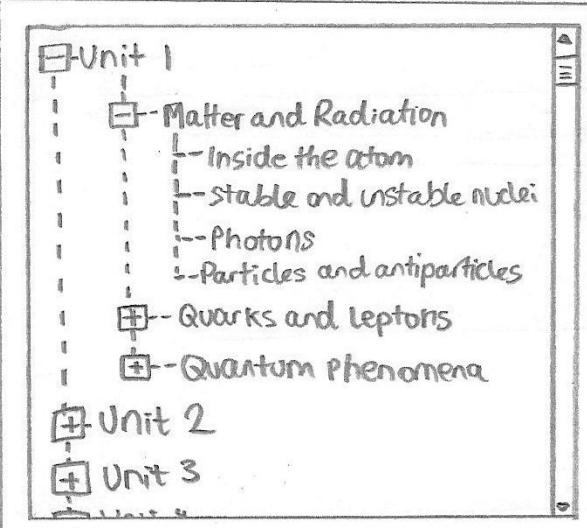
Quizzes

What are the SI units for mass?  
What is g to 2SF?  
What are the SI units for length?  
Which of the following does the constant 'c' represent?  
True or false? Light years are a measure of distance.

[QUESTION VIEWER PANE]

The current quiz being edited is displayed at the top of this form, along with a question viewer pane identical to the one above, below it. Questions can be selected from the viewer and added to the quiz (and from there, deleted if necessary.) The quiz can then be saved, exported or printed.

**Search Topics**



```

graph TD
    Unit1[Unit 1] --> Matter[Matter and Radiation]
    Matter --> Inside[Inside the atom]
    Matter --> Stable[Stable and unstable nuclei]
    Matter --> Photons[Photons]
    Matter --> Particles[Particles and antiparticles]
    Quarks[Quarks and leptons]
    Quantum[Quantum phenomena]

    Unit2[Unit 2]
    Unit3[Unit 3]
  
```

**Search Type**

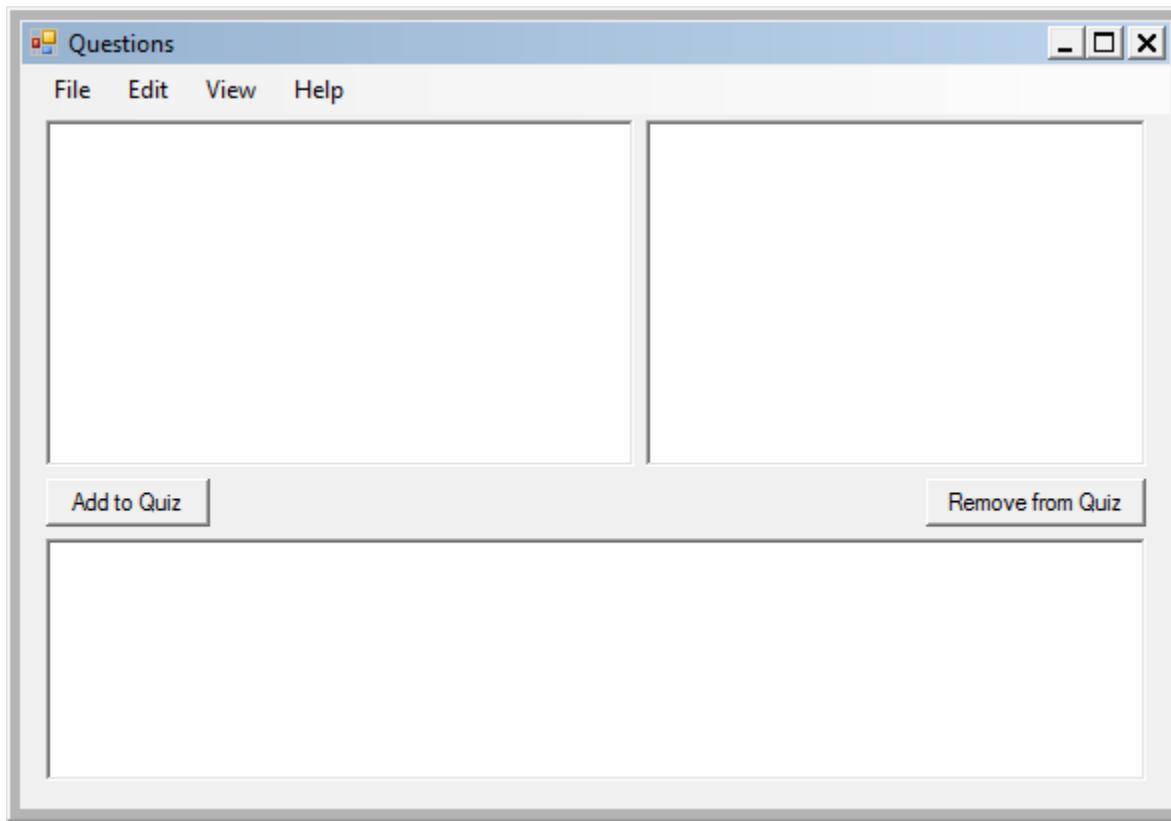
Multiple Choice

**Search Rating**

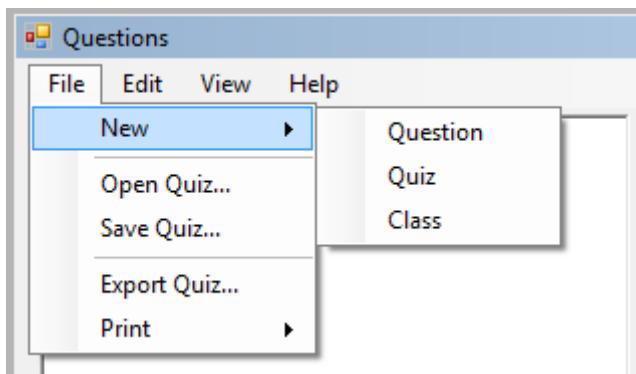
3/5

These search windows allow the user to filter the questions which are displayed to them by unit and topic, type, or difficulty rating. The unit and topic search is displayed as a tree, because presenting each unit as a parent node with broader topics as collapsible child nodes ensures that the user isn't overwhelmed with lists of text and can easily find the topic they want.

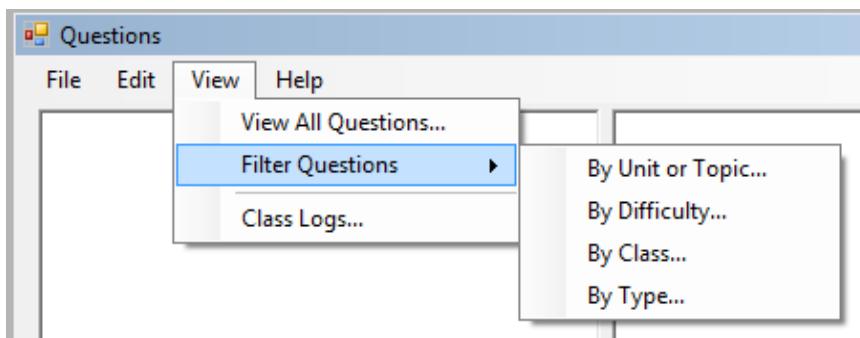
Visual Studio Form Design:



The main window comprises a question viewer pane at the top with a list of questions on the left and the answers and question information on the right. At the bottom is the quiz pane which displays all of the questions in the current quiz and allows the user to quickly add more or remove them.



The toolbar is based on the standard Windows toolbar for familiarity of use, and menu options are grouped by type.



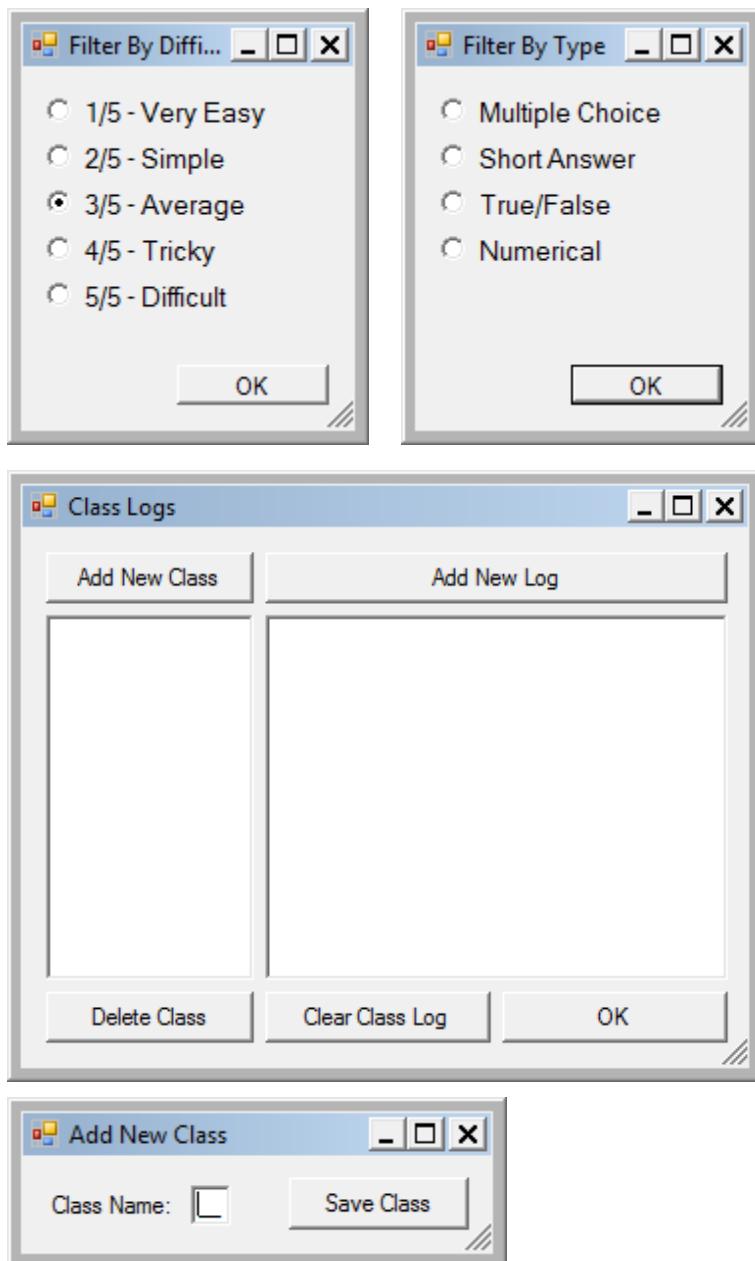
'View All Questions' would reset any search filters.

'Filter Questions' opens any of the filter dialogue boxes to enable the user to specify the filter terms.

The screenshot shows a 'Filter by Unit/Topic' dialog box. It displays a hierarchical tree structure of physics topics. The root node 'PHYA1 - Particles, Quantum Phenomena and Electricity' is expanded, showing its subtopics: Current Electricity, Electromagnetic Radiation and Quantum Phenomena, Particles and Radiation. Below these are nodes for PHYA2 - Mechanics, Materials and Waves, PHYA4 - Fields and Further Mechanics, and other topics like Capacitance, Electric Fields, etc. Each node has a '+' sign to expand and a '-' sign to collapse. The entire dialog box has a standard Windows-style title bar and control buttons.

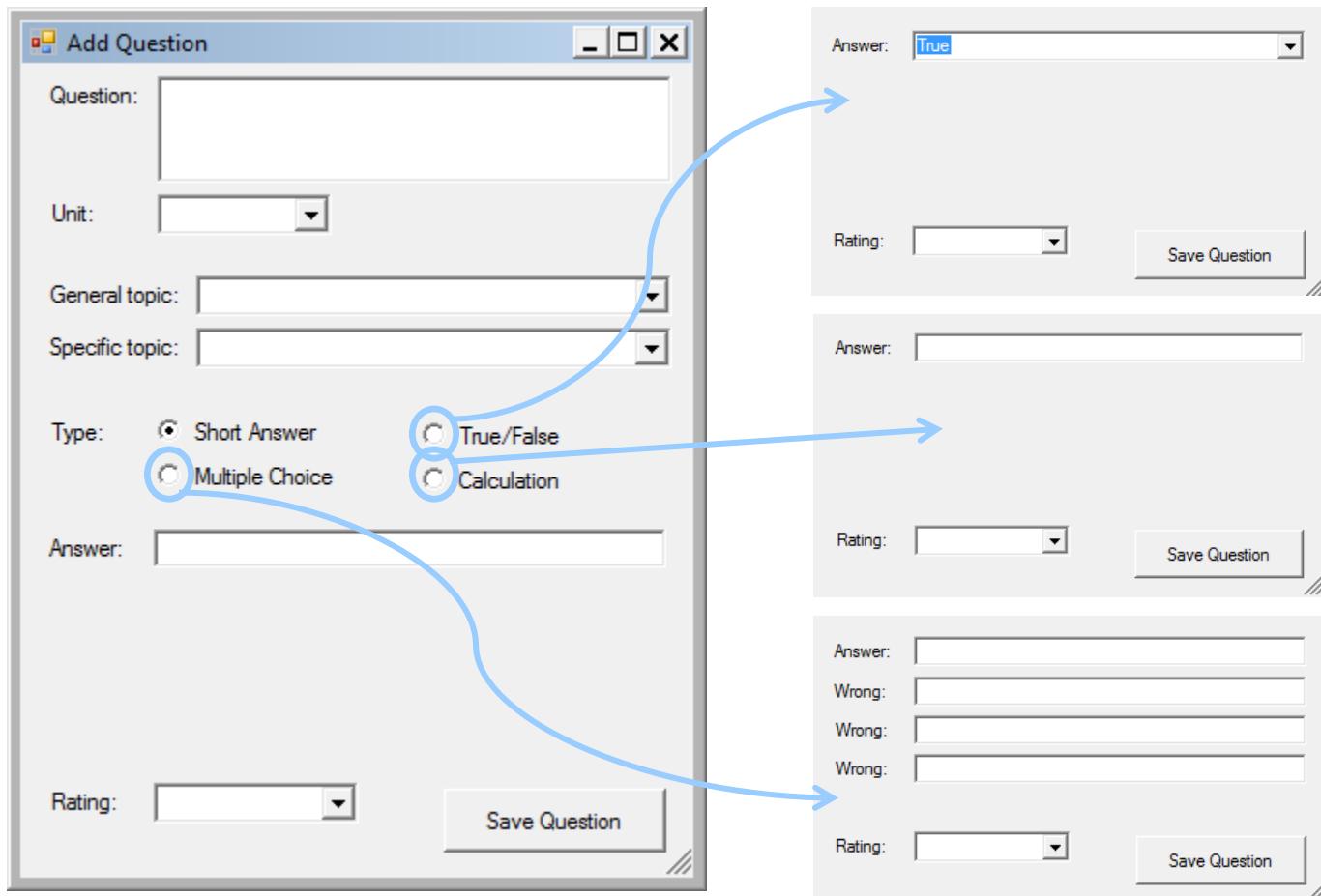
- PHYA1 - Particles, Quantum Phenomena and Electricity
  - Current Electricity
    - ... Alternating currents
    - ... Charge, current and potential difference
    - ... Circuits
    - ... Current/voltage characteristics
    - ... EMF and internal resistance
    - ... Oscilloscope
    - ... Potential divider
    - ... Resistivity
  - + Electromagnetic Radiation and Quantum Phenomena
  - + Particles and Radiation
- PHYA2 - Mechanics, Materials and Waves
  - + Materials
  - + Mechanics
  - Waves
    - ... Diffraction
    - ... Interference
    - ... Longitudinal and transverse waves
    - ... Progressive waves
    - ... Refraction at a plane surface
    - ... Superposition of waves, stationary waves
- PHYA4 - Fields and Further Mechanics
  - + Capacitance
  - Electric Fields
    - ... Comparison of electric and gravitational fields
    - ... Coulomb's law
    - ... Electric field strength
    - ... Electric potential
  - + Further Mechanics
  - + Gravitation

To filter by unit, general topic or specific topic the user would double-click the selected node in the tree. The first levels of nodes are units, the second are general topics and the third are specific topics. Parent nodes can be expanded or collapsed, a feature which improves navigation.



The ‘Filter By Class’ Dialogue would allow the user to view a list of all classes stored in the database and double-click any class to select. ‘Filter By Difficulty’ and ‘Filter By Type’ use radio buttons because the options available never change. The ‘Class Log’ form would show a list of all classes in the left pane, and the recent logs for the selected class in the right pane. From here, new logs or classes can be added.

Choosing ‘Add New Class’ opens the second class dialogue, where a new class with the name format used by the college – e.g. C1 – can be saved.



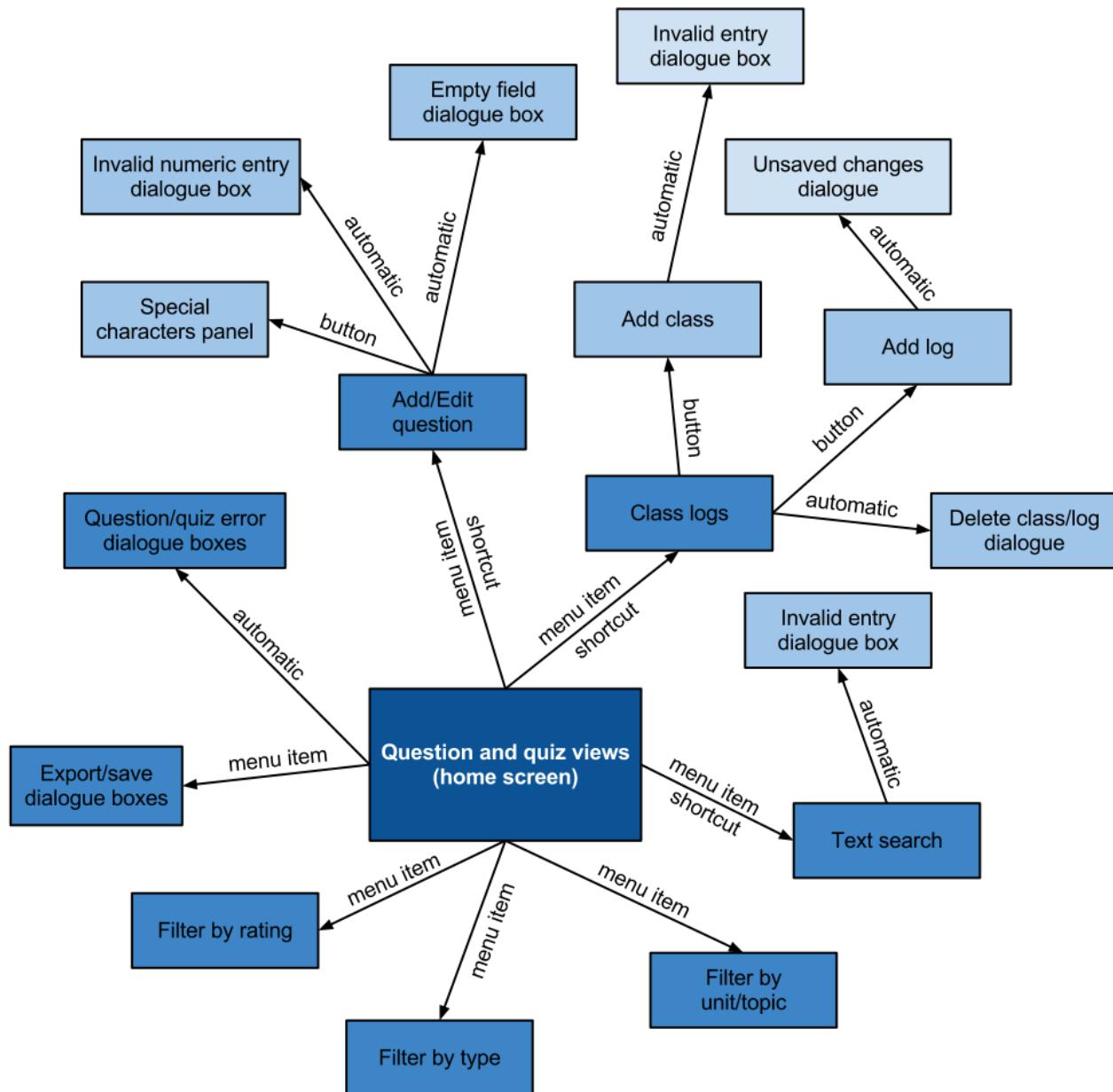
The screenshot shows the 'Add Question' dialog box and three separate answer entry panels. The dialog box contains fields for 'Question', 'Unit', 'General topic', 'Specific topic', 'Type' (radio buttons for 'Short Answer', 'Multiple Choice', 'True/False', and 'Calculation'), 'Answer', 'Rating', and a 'Save Question' button. The 'True/False' radio button is selected. The 'Multiple Choice' radio button is also highlighted with a blue circle. Three arrows point from these elements to the corresponding panels:

- An arrow points from the 'True/False' radio button to the top panel, which has an 'Answer' field containing 'True', a 'Rating' dropdown, and a 'Save Question' button.
- An arrow points from the 'Multiple Choice' radio button to the middle panel, which has an 'Answer' field, a 'Rating' dropdown, and a 'Save Question' button.
- An arrow points from the 'Save Question' button in the dialog box to the bottom panel, which has four 'Wrong:' fields and a 'Rating' dropdown.

The 'Add Question' form collects all the user-inputted data about new questions added to the database. Wherever possible (unit, topics, type, rating) the user has to select the data from existing list menus or radio buttons to minimise input errors and time-consuming form completion.

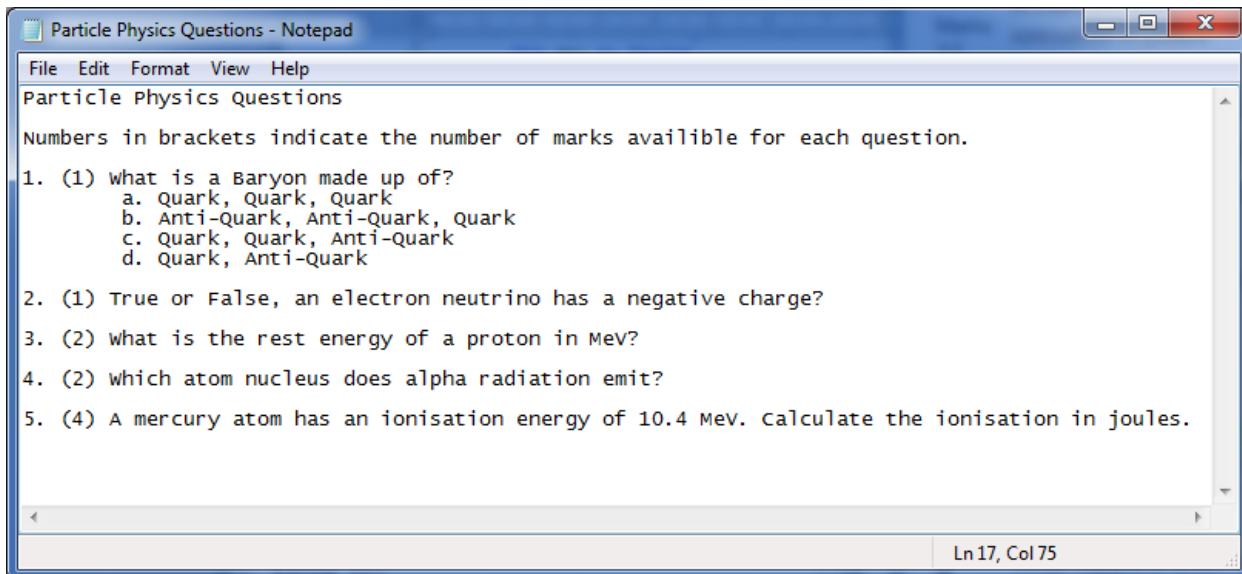
## Form Navigation Design

The following chart illustrates how users would navigate between all of the forms and dialogues in the new system, starting from the question/quiz viewer which is the home screen.



## Output Design

These text files are rough plans of the files the system should export. The first are the ‘hard copy’ files, i.e. those that won’t be uploaded to Moodle but will instead be saved or printed.



**Particle Physics Questions - Notepad**

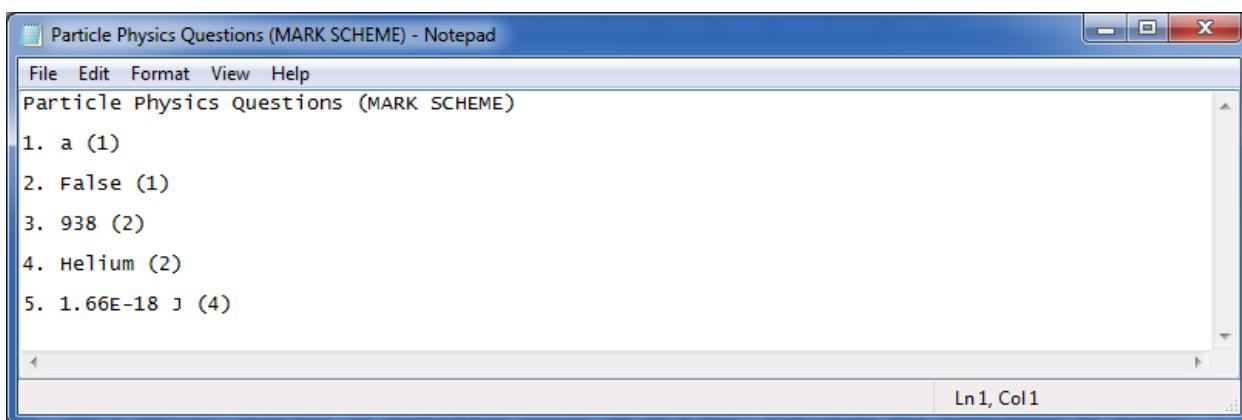
File Edit Format View Help

Particle Physics Questions

Numbers in brackets indicate the number of marks available for each question.

1. (1) what is a Baryon made up of?
  - a. Quark, Quark, Quark
  - b. Anti-Quark, Anti-Quark, Quark
  - c. Quark, Quark, Anti-Quark
  - d. Quark, Anti-Quark
2. (1) True or False, an electron neutrino has a negative charge?
3. (2) what is the rest energy of a proton in MeV?
4. (2) which atom nucleus does alpha radiation emit?
5. (4) A mercury atom has an ionisation energy of 10.4 Mev. calculate the ionisation in joules.

Ln 17, Col 75



**Particle Physics Questions (MARK SCHEME) - Notepad**

File Edit Format View Help

Particle Physics Questions (MARK SCHEME)

1. a (1)
2. False (1)
3. 938 (2)
4. Helium (2)
5.  $1.66E-18 \text{ J}$  (4)

Ln 1, Col 1

The next screenshots show the exported Gift files and how they would look when exported and uploaded to Moodle. There is no separate mark scheme file for Moodle, because it is integrated into the question file.

Particle Physics Moodle GIFT - Notepad

File Edit Format View Help

```
what is a Baryon made up of? {
=Quark, Quark, Quark
~Anti-Quark, Anti-Quark, quark
~Quark, Quark, Anti-Quark
~Quark, Anti-Quark
}

True or False, an electron neutrino has a negative charge? {F}

what is the rest energy of a proton in Mev? {#938}

which atom nucleus does alpha radiation emit? {=Helium}

A mercury atom has an ionisation energy of 10.4 MeV.
Calculate the ionisation in joules. {#1.66*10^-18}
```

Ln 19, Col 51

- 
- 1**  What is a Baryon made up of?  
Marks: --/1
- Choose one answer.
- a. Quark, Quark, Quark  
 b. Quark, Quark, Anti-Quark  
 c. Anti-Quark, Anti-Quark, Quark  
 d. Quark, Anti-Quark
- 
- 
- 2**  A mercury atom has an ionisation energy of 10.4 MeV. Calculate the ionisation in joules.  
Marks: --/1
- Answer:
- 
- 
- 3**  What is the rest energy of a proton in MeV?  
Marks: --/1
- Answer:
- 
- 
- 4**  Which atom nucleus does alpha radiation emit?  
Marks: --/1
- Answer:
- 
- 
- 5**  True or False, an electron neutrino has a negative charge?  
Marks: --/1
- Answer:
- True  
 False
-

## Algorithm Design

### Random Ordering of Multiple Choice Answers

#### Explanation

Every multiple choice question which is either exported or printed needs to have a different order of answers, i.e. the second option shown cannot always be the correct answer. This algorithm randomises the indexes of the array of four answers (three incorrect and one correct).

#### Pseudo-code

```
R ← Random(1, 4)
FOR EACH Question in newQuiz where Type ← "MC"
    Var incorrectAnswer[2]
    Var answer
    X ← R.Next
    IF x ← 1 Then Output answer, incorrectAnswer[0],
                  incorrectAnswer[1], incorrectAnswer[2]
    ELSEIF x ← 2 Then Output incorrectAnswer[0], answer,
                  incorrectAnswer[1], incorrectAnswer[2]
    ELSEIF x ← 3 Then Output incorrectAnswer[0],
                  incorrectAnswer[1], answer,
                  incorrectAnswer[2]
    ELSE: Output incorrectAnswer[0], incorrectAnswer[1],
          incorrectAnswer[2], answer
ENDIF
NEXT
```

### Question Text Search

#### Explanation

As well as being able to filter the questions in the viewer, users should be able to search for a string and have all questions which contain that string returned to them. A similar algorithm is used for the filtering.

#### Pseudo-code

```
Var found ← False
Var searchTerm
FOR i ← 0 to len[allQuestions] - 1
    IF question contains searchTerm THEN
        Found ← True
        Output question
    ENDIF
NEXT
IF Found ← False THEN Output "No questions found."
```

### Validating Question Entry

**Explanation**

Question entry and editing needs to be controlled by strict validation rules in order for questions to be filtered, and saved in a way which Moodle can mark. This validation would be done before any question is saved.

This function checks for the presence of a question, answer, unit, topic, question type and rating. If the question is a multiple choice one, it also checks for the presence of incorrect answers, and if the question is numerical, it checks it is an integer and doesn't contain characters which would cause an exception.

**Pseudo-code**

```
DO
    Var validQuestion ← True
    IF question ← "" or unit ← "" or topic ← "" or answer ← ""
        or type = "" or rating ← "" then validQuestion ← False
    ELSEIF type ← "MC" and incorrectAnswer[0] ← "" or
        incorrectAnswer[2] ← "" or incorrectAnswer[3] ←
        "" then validQuestion ← False
    ELSEIF type ← "NU"
        TRY INT(answer)
        CATCH validQuestion ← False
        END TRY
    ENDIF
LOOP UNTIL validQuestion = True
```

## Importing Questions from a Text File

### Explanation

This function reads all the questions in a collection in the system. For each question, if the question body is stored on the nth line, the type will be on the (n+1)th line, the answer on the (n+2)th line and so on. Each question will be saved over nine lines.

### Pseudo-code

```

IF file exists
    Var allQuestions[]
    Var allLines[] ← file
    Var count ← 0
    FOR i ← 0 to LEN(file) - 8 STEP 9
        count ← count + 1
        question.QID ← count
        question.text ← allLines[i]
        question.type ← allLines[i+1]
        question.answer ← allLines[i+2]
        IF type = "MC" THEN
            question.incorrectAnswer[0] ← allLines[i+3]
            question.incorrectAnswer[1] ← allLines[i+4]
            question.incorrectAnswer[2] ← allLines[i+5]
        END IF
        question.unit ← allLines[i+6]
        question.topic ← allLines[i+7]
        question.rating ← allLines[i+8]
        allQuestions.add(question)
    NEXT
END IF

```

## Checking for Repeated Questions

### Explanation

The system has to be able to notify the user if they are adding a duplicate question to the quiz so it isn't accidentally assigned twice.

### Pseudo-code

```

IF listItemIndex > -1 THEN
    Var question ← allQuestions(listItemIndex)
    If newQuiz CONTAINS (question) THEN
        Output "This question is already in the quiz."
    ELSE: newQuiz.add(question)
END IF

```

## Converting Questions to Moodle's Gift Format

### Multiple Choice

<b>General format</b>	<b>Example</b>
Question { =CorrectAnswer ~IncorrectAnswer ~IncorrectAnswer ~IncorrectAnswer } }	What is the SI unit for mass? { =Kilograms ~Newtons ~Metres ~Kelvin }
<b>Pseudo-code</b>	
Output question & "{ " & newline & "=" & answer & newline & incorrectAnswer[0] & newline & incorrectAnswer[1] & newline & incorrectAnswer[2] & newline & "}" & newline & newline	

### True/False

<b>General format</b>	<b>Example</b>
Question {T} or Question {F}	Kilograms are the SI unit for mass. {T}  Metres are the SI unit for mass. {F}
<b>Pseudo-code</b>	
If answer ← "true" then Output question & "{T}" Else: Output question & "{F}" End if	

### Short Answer

<b>General format</b>	<b>Example</b>
Question{=CorrectAnswer}	What are kilograms the SI unit for?{=Mass}
<b>Pseudo-code</b>	
Output question & "{=" & answer & "}"	

### Numerical

<b>General format</b>	<b>Example</b>
Question {"#Answer"}	How many grams in a kilogram? {"#1000"}
<b>Pseudo-code</b>	
Output question & "{#" & answer & "}"	

## Identification of Storage Media

As the software has been designed for a fairly specific purpose and therefore should not be large, I calculate that the executable install file should be small, taking up less than 1 megabyte of space. When the system is used, the question data, class data and unit/topic data are all written to plain text files. These are saved in the user directory and should not exceed 5 megabytes. These small file sizes mean that I could choose to distribute the system in a number of ways.

The user could download the executable from a secure online location, but the college has a strict firewall which may make this difficult, and also means the user will have to be connected to the internet during the installation process. On a slow connection, this would be impractical. It also means the file would have to remain online and accessible indefinitely in case a reinstall is required.

The system could also be installed from a CD-ROM (CD-RW discs are unnecessary because data will only be read from and not written to the disc after the executable is initially copied) which can store 194 megabytes of data. The disc could then be kept to install the system on other devices. However, as the disc would only contain the installation file, a large amount of space that cannot be overwritten would be wasted. There is also the consideration that as the pressure on laptops and netbooks to become more portable and smaller in dimension increases, many machines will no longer have an internal CD/DVD drive.

My choice for the storage of the executable file would be on a USB flash-drive, for several reasons. The file itself wouldn't create any wasted space on the flash drive, as the rest of the drive could still be read to and written from as usual. Teachers in the departments tend to already own flash drives and could therefore keep backup copies of the executable on these instead of having to store physical CDs, and no internet connection is required during the installation process. As USB ports are an industry standard on laptops and desktops for the foreseeable future, this ensures that even as the hardware in the Physics department at the college is updated, as long as the .NET framework is kept updated, the software can still be installed. One of the machines from which I will be writing the system does not have a CD/DVD drive, and so from a programmer's perspective it is also a great deal easier to store the executable files on a USB flash drive. Installation speeds from USB 2.0 and 3.0 are both faster than installation speeds from a CD-ROM, which is another advantage.

## Testing Plan

To ensure the system will be able to correctly handle all user inputs (both correct and incorrect) as well as correctly navigate between forms and execute algorithms correctly, I have planned several testing methods.

### Input and Output Testing Design

The following table is designed to test the actual outcome vs. the expected outcome for every user input and system output in the case of typical (correct and expected) data, erroneous (would cause the system to throw an exception, e.g. Incorrect data types) data and extreme data (less expected data, e.g. Blank fields or boundary data).

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
1	Adding a question	T: All fields filled in	Question is added to the pane and form closes.		
		E: Blank field/s	'Please enter _____' dialogue. Form stays open.		
2	Editing a question	T: There is a question selected	Edit question form loads with existing data, and when saved, question updates in the question pane and, if applicable, the quiz.		
		E: None selected	'Please select a question' dialogue.		
3	Deleting a question	T: There is a question selected	'Are you sure' dialogue, and if yes then question is deleted from the pane and if applicable, the quiz.		
		E: None selected	'Please select a question' dialogue.		
4	Adding a question to the quiz	T: Question selected	Question appears in the quiz pane.		
		E: No question selected	'Please select a question' dialogue.		
		X: Question is already in quiz	'Already in quiz' dialogue. Question does not appear in the quiz pane.		

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
5	Removing a question from the quiz	T: Question selected (in the quiz pane)	'Are you sure' dialogue. If yes, question is removed from the quiz pane.		
		E: No question selected	'Please select a question' dialogue.		
6	Filter by difficulty	T: Any radio button selected	Question pane refreshes to show all questions of that difficulty.		
		X: No questions of that difficulty	Question pane shows no questions.		
7	Filter by unit/topic	T: Any node selected	Question pane refreshes to show all questions of that unit/topic.		
		X: No questions of that unit/topic	Question pane shows no questions.		
8	Filter by type	T: Any radio button selected	Question pane refreshes to show all questions of that type.		
		X: No questions of that type	Question pane shows no questions.		
9	View class logs	T: logs may or may not already exist	All class logs are loaded from document (document is created if it doesn't exist,) log field will be blank if there is no saved log.		
10	Add class	T: Class name field is filled in	Class is added to the list on the logs form		
		E: Class name field is blank	'Please provide a class name' dialogue.		
11	Add/edit log	T: There is a class selected	Add/edit form loads (with existing log if there is one.)		
12	Delete Class	T: There is a class selected	'Are you sure' dialogue. If yes, the class is deleted.		
13	Delete Log	T: There is a class selected	'Are you sure' dialogue. If yes, the log is deleted.		

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
14	Save quiz (text-based)	T: The quiz contains questions.	Save dialogue opens and two text files are saved. One quiz and one mark scheme with the same filename as entered for the quiz suffixed by "(mark scheme.)"		
		E: The quiz contains no questions.	'Quiz contains no questions' dialogue. Nothing is exported.		
15	Export quiz (for Moodle)	T: The quiz contains questions.	Save dialogue opens and one text file with integrated answers is saved. This can be uploaded to Moodle with no editing.		
		E: The quiz contains no questions.	'Quiz contains no questions' dialogue. Nothing is exported.		
16	Loading questions	T: Question files exist and contain question data	All questions are loaded into the question pane.		
		T: Question files do not exist	'Welcome to Benchmark' dialogue. (Files not existing suggest this is the first time the system has been run.)		
		T: Question files exist but do not contain question data	'You haven't added any questions yet' dialogue. (Blank files suggest the system has been run before.)		

## Navigation Testing Design

To be able to see at a glance which forms are linked to each other and which can only navigate through other forms, I've created a table. It is unidirectional (being able to navigate from form A to B for example does not mean that the user can directly navigate from form B back to A, it may only be able to return focus to A upon closing.)

The table can simply be filled in with ticks or crosses to test the navigation works as expected. Until implementation is complete, I cannot know for sure how many forms there will be in the system so the following table with forms A-H is merely an estimate. The finished system could have more or less, but not drastically so.

<b>Navigating from: →</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>
<b>Navigating to: ↓</b>								
<b>A</b>								
<b>B</b>								
<b>C</b>								
<b>D</b>								
<b>E</b>								
<b>F</b>								
<b>G</b>								
<b>H</b>								

# Testing

---

## Input and Output Testing

This table is an overview of the basic input and output tests conducted on the system in order to make sure the expected outcome of every action is the actual outcome when using the system. Pale blue rows indicate tests that were not featured in the original plan, for features which were added during implementation.

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
1	Adding a question	T: All fields filled in	Question is added to the pane and form closes.	As expected. <sup>1</sup>	None required.
		E: Blank field/s	'Please enter _____' dialogue. Form stays open.	As expected. <sup>2</sup>	None required.
		E: Invalid character in number field		As expected. <sup>3</sup>	
2	Editing a question	T: There is a question selected	Edit question form loads with existing data, and when saved, question updates in the question pane and, if applicable, the quiz.	As expected. <sup>4</sup>	None required.
		E: None selected	'Please select a question' dialogue.	As expected. <sup>5</sup>	None required.

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
3	Deleting a question	T: There is a question selected	'Are you sure' dialogue, and if yes then question is deleted from the pane and if applicable, the quiz.	As expected. <sup>6</sup>	None required.
		E: None selected	'Please select a question' dialogue.	As expected. <sup>7</sup>	None required.
4	Adding a question to the quiz	T: Question selected	Question appears in the quiz pane.	As expected. <sup>8</sup>	None required.
		E: No question selected	'Please select a question' dialogue.	As expected. <sup>9</sup>	None required.
		X: Question is already in quiz	'Already in quiz' dialogue. Question does not appear in the quiz pane.	'Already in quiz' appears but question is still added to the quiz. <sup>10</sup>	Exit the IF statement before the question is added. Second test conducted (4b.)
4(b)	Adding a question to the quiz (REPEATED TEST)	X: Question is already in quiz	'Already in quiz' dialogue. Question does not appear in the quiz pane.	As expected. <sup>11</sup>	None required.
5	Removing a question from the quiz	T: Question selected (in the quiz pane)	'Are you sure' dialogue. If yes, question is removed from the quiz pane.	As expected. <sup>12</sup>	None required.
		E: No question selected	'Please select a question' dialogue.	As expected. <sup>13</sup>	None required.

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
6	Text search	T: Question(s) contain the search term	Question pane refreshes to show all questions that contain the term.	As expected. <sup>14</sup>	None required.
		E: Blank search field	'Please enter a search term' dialogue.	As expected. <sup>15</sup>	None required.
		X: Valid search field but no questions contain the search term	'No question found' dialogue. Question pane shows no questions.	As expected. <sup>16</sup>	None required.
7	Filter by difficulty	T: Any radio button selected	Question pane refreshes to show all questions of that difficulty.	As expected. <sup>17</sup>	None required.
		X: No questions of that difficulty	Question pane shows no questions.	As expected. <sup>18</sup>	None required.
8	Filter by unit/topic	T: Any node selected	Question pane refreshes to show all questions of that unit/topic.	As expected. <sup>19</sup>	None required.
		X: No questions of that unit/topic	Question pane shows no questions.	As expected. <sup>20</sup>	None required.
9	Filter by type	T: Any radio button selected	Question pane refreshes to show all questions of that type.	As expected. <sup>21</sup>	None required.

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
		X: No questions of that type	Question pane shows no questions.	As expected. <sup>22</sup>	None required.
10	Alphabetically sort	T: There are saved questions	Questions are sorted alphabetically	As expected. <sup>23</sup>	None required.
		E: allQuestions is empty	No action.	As expected. <sup>24</sup>	None required.
11	View class logs	T: logs may or may not already exist	All class logs are loaded from document (document is created if it doesn't exist,) log field will be blank if there is no saved log.	If the form has already been loaded, classes are loaded again without the original list being cleared. <sup>25</sup>	Clear the class list every time the form loads. Second test conducted (11b.)
11 (b)	View class logs (REPEATED TEST)	T: logs may or may not already exist	All class logs are loaded from document (document is created if it doesn't exist,) log field will be blank if there is no saved log.	As expected. <sup>26</sup>	None required.
12	Add class	T: Class name field is filled in	Class is added to the list on the logs form.	As expected. <sup>27</sup>	None required.
		E: Class name field is blank	'Please provide a class name' dialogue.	As expected. <sup>28</sup>	None required.
13	Add/edit log	T: There is a class selected	Add/edit form loads (with existing log if there is one.)	As expected. <sup>29</sup>	None required.

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
14	Delete Class	T: There is a class selected	'Are you sure' dialogue. If yes, the class is deleted.	As expected. <sup>30</sup>	None required.
15	Delete Log	T: There is a class selected	'Are you sure' dialogue. If yes, the log is deleted.	As expected. <sup>31</sup>	None required.
16	Save quiz (text-based)	T: The quiz contains questions.	Save dialogue opens and two text files are saved. One quiz and one mark scheme with the same filename as entered for the quiz suffixed by "(mark scheme.)"	As expected. <sup>32</sup>	None required.
		E: The quiz contains no questions.	'Quiz contains no questions' dialogue. Nothing is exported.	As expected. <sup>33</sup>	None required.
17	Export quiz (for Moodle)	T: The quiz contains questions.	Save dialogue opens and one text file with integrated answers is saved. This can be uploaded to Moodle with no editing.	As expected. <sup>34</sup>	None required.

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
		E: The quiz contains no questions.	'Quiz contains no questions' dialogue. Nothing is exported.	As expected. <sup>35</sup>	None required.
18	Loading questions	T: Question files exist and contain question data	All questions are loaded into the question pane.	As expected. <sup>36</sup>	None required.
		E: Question files do not exist	'Welcome to Benchmark' dialogue. (Files not existing suggest this is the first time the system has been run.)	As expected. <sup>37</sup>	None required.
		X: Question files exist but do not contain question data	'You haven't added any questions yet' dialogue. (Blank files suggest the system has been run before.)	As expected. <sup>38</sup>	None required.
19	Random ordering of multiple choice answers when saving quizzes	T: Quiz contains multiple choice questions	For test data where answers are "Correct" "X" "Y" "Z", each of the four elements should be in a different order for each question.	As expected. Input <sup>39</sup> produces output <sup>40</sup> . However, numbering is zero-based.	Begin numbering at i=1 rather than i=0 so quizzes begin at question one. Second test conducted (19b.)

<b>Test No.</b>	<b>Description</b>	<b>TEX (Typical, Erroneous, Extreme)</b>	<b>Expected Outcome</b>	<b>Actual Outcome</b>	<b>Comments and Corrective Actions</b>
19 (b)	Random ordering of multiple choice answers when saving quizzes (REPEAT TEST)	T: Quiz contains multiple choice questions	As for (19) but numbering should begin at 1 rather than 0.	As expected. Input <sup>41</sup> produces output <sup>42</sup> .	None required.
20	Testing the saving and loading of system files on the college network	T: Saving typical question data	Question is saved and written to the text file	Question is not saved because my user profile doesn't have permission to access the directory. <sup>43</sup> Attempting to navigate to the folder also results in an error message. <sup>44</sup>	Change the "userdirectory" environment variable to the Environment.Special Folder.Mydocuments variable in every instance of a file being written or read. Second test conducted (20b.)
20 (b)	Testing the saving and loading of system files on the college network (REPEAT TEST)	T: Saving typical question data	As for (20)	As expected. <sup>45</sup>	

## Trace Tables

### Testing the output from filtering questions by difficulty rating

#### Description:

The search algorithm iterates through every element in allQuestions, adding any elements with a matching question rating to lstAllQuestions. I'm searching 15 questions for any that have a difficulty rating of two. The same principle would apply when searching by unit, topic or question type.

#### Code being tested:

```
Sub filterDifficulty(ByVal rating)
    lstQuestions.Items.Clear()
    For i = 0 To allQuestions.Count - 1
        If allQuestions.ElementAt(i).getQRating = rating Then
            lstQuestions.Items.Add(allQuestions(i).getQID & " " & vbTab
                & allQuestions(i).getQText & "(" &
                allQuestions(i).getQAnswer & ")" [" &
                allQuestions(i).getQTopic & ", " &
                allQuestions(i).getQRating & "]")
        End If
    Next
    Call countLists()
End Sub
```

#### Expected result:

list display of allQuestions(2)

list display of allQuestions(6)

list display of allQuestions(10)

list display of allQuestions(11)

list display of allQuestions(12)

where “list display of allQuestions(i)” denotes:

(allQuestions(i).getQID & " " & vbTab & allQuestions(i).getQText & "(" &  
 allQuestions(i).getQAnswer & ")" [" & allQuestions(i).getQTopic & ", " &  
 allQuestions(i).getQRating & "]")

<b>i</b>	<b>allQuestions.count</b>	<b>rating</b>	<b>allQuestions(i).getQRating</b>	<b>Output</b>
0	14	2	1	
1			1	
2			2	list display of allQuestions(2)
3			1	
4			1	
5			1	
6			2	list display of allQuestions(6)
7			1	
8			1	
9			3	
10			2	list display of allQuestions(10)
11			2	list display of allQuestions(11)
12			2	list display of allQuestions(12)
13			1	
14			1	

**Final output (As expected):**

List display of allQuestions(2)  
 List display of allQuestions(6)  
 List display of allQuestions(10)  
 List display of allQuestions(11)  
 List display of allQuestions(12)

### Testing the loading of questions into the system from a text file

#### Description:

The import algorithm reads the lines of the text file into a 1-dimensional array called allLines() and then reads every 9 consecutive lines and assigns these lines to the properties of a newly instantiated question. Each one of these questions is added to the allQuestions collection before the next is looped through. For this test, I'll be importing 15 questions from a text file.

#### Code being tested:

```
Dim count As Integer = 0
    For i = 0 To allLines.Length - 8 Step 9
        Dim savedQuestion As New Question
        savedQuestion.setQID(count + 1)
        savedQuestion.setQText(allLines(i))
        savedQuestion.setQType(allLines(i + 1))
        savedQuestion.setQAnswer(allLines(i + 2))
        If savedQuestion.getQType = "MC" Then
            savedQuestion.setIncorrect(allLines(i + 3), 0)
            savedQuestion.setIncorrect(allLines(i + 4), 1)
            savedQuestion.setIncorrect(allLines(i + 5), 2)
        End If
        savedQuestion.setQUnit(allLines(i + 6))
        savedQuestion.setQTopic(allLines(i + 7))
        savedQuestion.setQRating(allLines(i + 8))
        count = count + 1
        allQuestions.Add(savedQuestion)
```

[Next](#)

#### Expected result:

For every incrementation of count, allQuestions(count) should contain data from lines [count \* 9] to [(count + 1) \* 9 - 1], starting at line 0

#### Abbreviations used:

SQ(i) – savedQuestion(i)

AL(i) – allLines(i)

<b>i</b>	<b>count</b>	<b>SQ.getQID</b>	<b>SQ.getText</b>	<b>SQ.getType</b>	<b>SQ.getQAnswer</b>	<b>SQ.getIncorrect(0)</b>	<b>SQ.getIncorrect(1)</b>	<b>SQ.getIncorrect(2)</b>	<b>SQ.getQUUnit</b>	<b>SQ.getTopic</b>	<b>SQ.getQRating</b>
0	0	1	AL(0)	AL(1)	AL(2)	AL(3)	AL(4)	AL(5)	AL(6)	AL(7)	AL(8)
9	1	2	AL(9)	AL(10)	AL(11)	AL(12)	AL(13)	AL(14)	AL(15)	AL(16)	AL(17)
18	2	3	AL(18)	AL(19)	AL(20)	AL(21)	AL(22)	AL(23)	AL(24)	AL(25)	AL(26)
27	3	4	AL(27)	AL(28)	AL(29)	AL(30)	AL(31)	AL(32)	AL(33)	AL(34)	AL(35)
36	4	5	AL(36)	AL(37)	AL(38)	AL(39)	AL(40)	AL(41)	AL(42)	AL(43)	AL(44)
45	5	6	AL(45)	AL(46)	AL(47)	AL(48)	AL(49)	AL(50)	AL(51)	AL(52)	AL(53)
54	6	7	AL(54)	AL(55)	AL(56)	AL(57)	AL(58)	AL(59)	AL(60)	AL(61)	AL(62)
63	7	8	AL(63)	AL(64)	AL(65)	AL(66)	AL(67)	AL(68)	AL(69)	AL(70)	AL(71)
72	8	9	AL(72)	AL(73)	AL(74)	AL(75)	AL(76)	AL(77)	AL(78)	AL(79)	AL(80)
81	9	10	AL(81)	AL(82)	AL(83)	AL(84)	AL(85)	AL(86)	AL(87)	AL(88)	AL(89)
90	10	11	AL(90)	AL(91)	AL(92)	AL(93)	AL(94)	AL(95)	AL(96)	AL(97)	AL(98)
99	11	12	AL(99)	AL(100)	AL(101)	AL(102)	AL(103)	AL(104)	AL(105)	AL(106)	AL(107)
108	12	13	AL(108)	AL(109)	AL(110)	AL(111)	AL(112)	AL(113)	AL(114)	AL(115)	AL(116)
117	13	14	AL(117)	AL(118)	AL(119)	AL(120)	AL(121)	AL(122)	AL(123)	AL(124)	AL(125)
126	14	15	AL(126)	AL(127)	AL(128)	AL(129)	AL(130)	AL(131)	AL(132)	AL(133)	AL(134)

**Final collection (As expected):**

The table shows a representation of each property stored in the elements of the collection; data has been loaded as expected. For every incrimination of count, allQuestions(count) contains data from lines [count \* 9] to [(count + 1) \* 9 – 1], starting at line 0.

## Navigation Testing

The following table tests the unidirectional navigation between forms which link to each other. Blue cells indicate forms are not linked. Grey cells indicate there is no need for navigation. The key is as follows:

frmAddEditQuestion	-	A
frmAddLog	-	B
frmAddNewClass	-	C
frmClassLogs	-	D
frmFilterDifficulty	-	E
frmFilterType	-	F
frmFilterUnitTopic	-	G
frmHome	-	H
frmTextSearch	-	I

Navigation successful



No direct navigation, but focus returned to correct form upon closing



Navigation unsuccessful

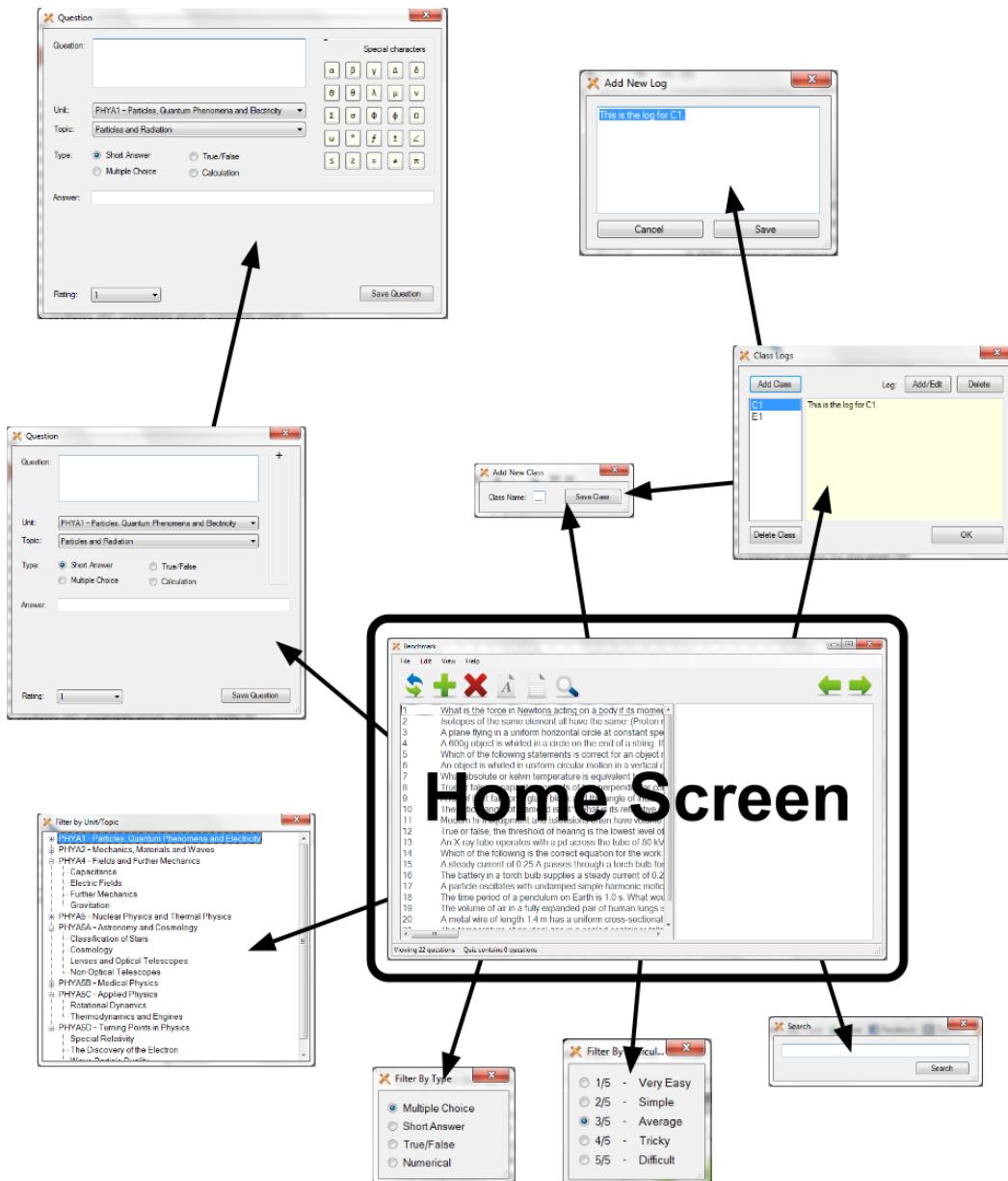


Navigating from: →	A	B	C	D	E	F	G	H	I
Navigating to: ↓	A	B	C	D	E	F	G	H	I
<b>A</b>								✓	
<b>B</b>				✓					
<b>C</b>				✓				✓	
<b>D</b>		✓	✓					✓	
<b>E</b>								✓	
<b>F</b>								✓	
<b>G</b>								✓	
<b>H</b>	✓			✓	✓	✓	✓		✓
<b>I</b>								✓	

# Maintenance

## Form Navigation Overview

The diagram below illustrates how all the forms of the system link to each other. Compare with navigation design and testing on pages 55 and 78.



## Class Overview

There are two classes from which objects are instantiated, modelled on their real counterparts.

### Group

(Every teaching group in the department)

Private properties:

groupName  
groupLog

Public methods:

getGroupName  
getGroupLog  
setGroupName()  
setGroupLog()

### Question

(Every question in the system)

Private properties:

qText  
qAnswer  
qUnit  
qTopic  
qType  
qIncorrect(2)  
qID  
qRating

Public methods:

getQText  
getQAnswer  
getQUnit  
getQTopic  
getQType  
getIncorrect()  
getQRating  
getQID  
setQText()  
setQAnswer()  
setQUnit()  
setQTopic()  
setQType()  
setQIncorrect()  
setQRating

```
Public Class Group
```

```
    Dim groupName, GroupLog As String
    Public Sub setGroupName(ByVal name)
        groupName = name
    End Sub
    Public Function getGroupName()
        Return groupName
    End Function
    Public Sub setGroupLog(ByVal log)
        GroupLog = log
    End Sub
    Public Function getGroupLog()
        Return GroupLog
    End Function
End Class
```

---

```
Public Class Question
```

```
    Private qText, qAnswer, qUnit, qTopic, qType As String
    Private qID, qRating As Integer
    Private qIncorrect(2) As String

    Public Sub setQText(ByVal text)
        qText = text
    End Sub
    Public Function getQText()
        Return qText
    End Function
    Public Sub setQAnswer(ByVal answer)
        qAnswer = answer
    End Sub
    Public Function getQAnswer()
        Return qAnswer
    End Function
    Public Function getIncorrect(ByVal x)
        Return qIncorrect(x)
    End Function
    Public Sub setIncorrect(ByVal incorrect, ByVal x)
        qIncorrect(x) = incorrect
    End Sub
    Public Sub setQTopic(ByVal topic)
        qTopic = topic
    End Sub
    Public Function getQTopic()
```

```
        Return qTopic
    End Function
    Public Sub setQUnit(ByVal unit)
        qUnit = unit
    End Sub
    Public Function getQUnit()
        Return qUnit
    End Function
    Public Sub setQID(ByVal id)
        qID = id
    End Sub
    Public Function getQID()
        Return qID
    End Function
    Public Sub setQRating(ByVal rating)
        qRating = rating
    End Sub
    Public Function getQRating()
        Return qRating
    End Function
    Public Sub setQType(ByVal type)
        qType = type
    End Sub
    Public Function getQType()
        Return qType
    End Function

End Class
```

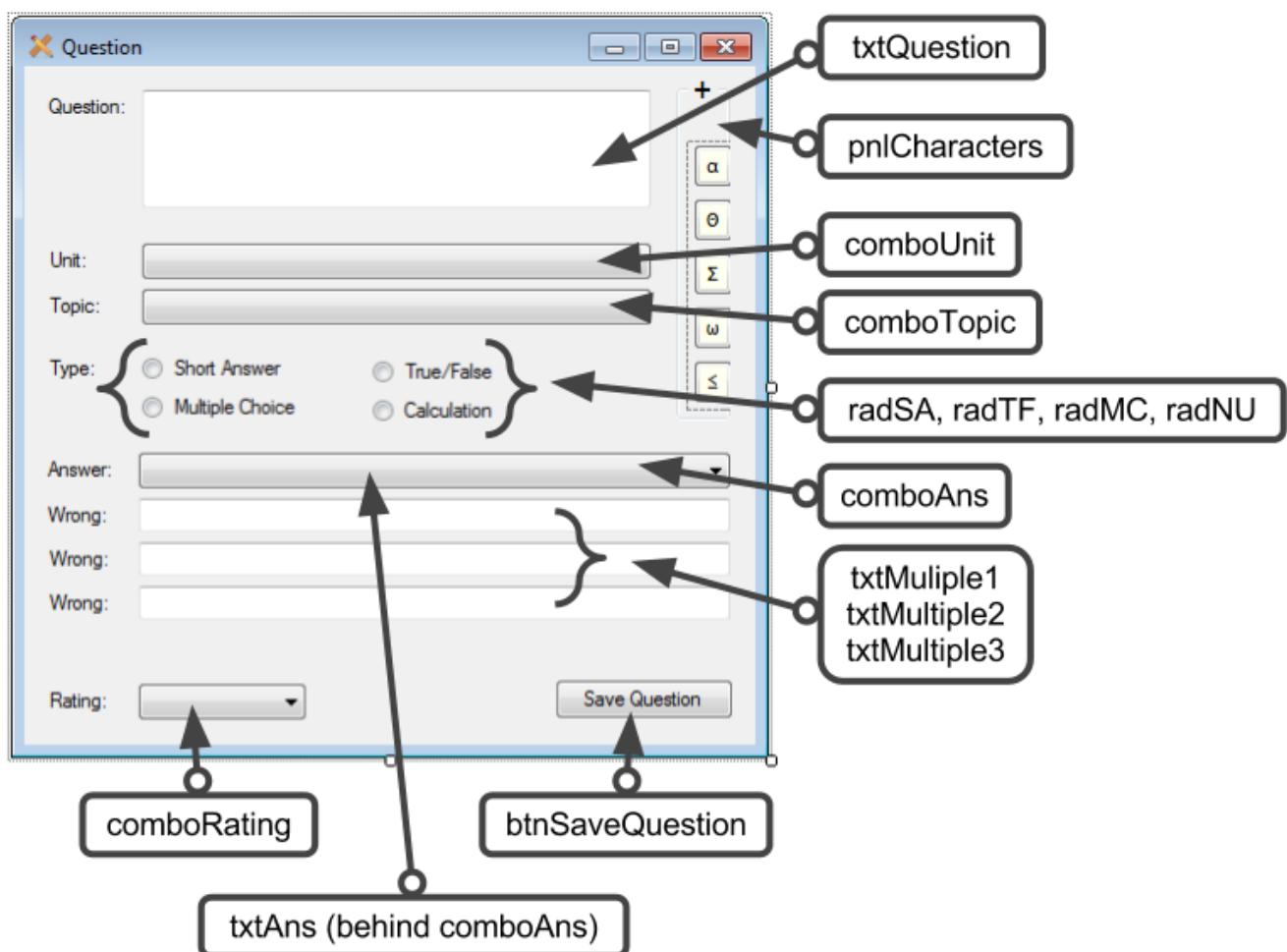
---

## Form Overview

Excluding dialogues, there are nine forms that make up the system.

### frmAddEditQuestion

Handles the input and of new question data, the editing of existing question data and the validation of all question data in the system.



```
Public Class frmAddEditQuestion
```

```
    Friend allquestions As New
    System.Collections.ObjectModel.Collection(Of Question)
    'Friend modifier makes the allquestions collection accessible in
    'this form
    Dim questionType As String
    Dim editing As Boolean
```

```

'Public questiontype variable and editing boolean are accessed by
a majority of subroutines

Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
    Me.MinimizeBox = False
    Me.MaximizeBox = False
    Me.MaximumSize = New Point(450, 440)
    'Resets the size of the form to the default, with the panel
collapsed
    If editing = False Then
        'If the form has been called to add a question rather than
edit, clear the units combo box
        comboUnit.Items.Clear()
        'Gets the user directory name by retrieving the
environment variable "userprofile"
        Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
        If System.IO.File.Exists(userDirectory &
"\Benchmark\Units.txt") Then
            Dim allLines() As String =
System.IO.File.ReadAllLines(userDirectory & "\Benchmark\Units.txt")
            'If the file exists, load existing units into the
combo box
            If allLines.Length > 0 Then
                For i = 0 To allLines.Length - 1
                    'Iterate through the lines of the file,
reading a unit from each line
                    comboUnit.Items.Add(allLines(i))
                Next
                comboUnit.Update()
            End If
        End If
        comboUnit.SelectedIndex = 0
    End If
End Sub
Private Sub cancelChanges(ByVal sender As Object, ByVal e As
FormClosingEventArgs) Handles Me.FormClosing
    'In the event that the form is closing, whether or not the
user clicked 'save'
    editing = False
    'Resets the editing boolean so the form can load with empty
fields if necessary
    'Clears the text boxes
    Call clearQuestion()
End Sub

```

```

    Private Sub SASelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radShortAns.CheckedChanged
        'Changes the question type of the question being created to
        the short answer type
        'Hides the form controls associated with multiple choice and
        true/false questions
        questionType = "SA"
        txtAns.Visible = True
        txtMultiple1.Visible = False
        txtMultiple2.Visible = False
        txtMultiple3.Visible = False
        comboAns.Visible = False
        Label8.Visible = False
        Label9.Visible = False
        Label10.Visible = False
    End Sub
    Private Sub NUSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radCalculation.CheckedChanged
        'Changes the question type of the question being created to
        the numerical answer type
        'Hides the form controls associated with multiple choice and
        true/false questions
        questionType = "NU"
        txtAns.Visible = True
        txtMultiple1.Visible = False
        txtMultiple2.Visible = False
        txtMultiple3.Visible = False
        comboAns.Visible = False
        Label8.Visible = False
        Label9.Visible = False
        Label10.Visible = False
    End Sub
    Private Sub TFSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles RadTrueFalse.CheckedChanged
        'Changes the question type of the question being created to
        the true/false type
        'Hides the form controls associated with multiple choice
        questions
        questionType = "TF"
        txtAns.Visible = False
        txtMultiple1.Visible = False
        txtMultiple2.Visible = False
        txtMultiple3.Visible = False
        comboAns.Visible = True
    End Sub

```

```

        Label8.Visible = False
        Label9.Visible = False
        Label10.Visible = False
        comboAns.SelectedIndex = 0
    End Sub
    Private Sub MCSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radMultipleChoice.CheckedChanged
        'Changes the question type of the question being created to
        the multiple choice type
        'Hides the form controls associated with true/false questions
        questionType = "MC"
        txtAns.Visible = True
        txtMultiple1.Visible = True
        txtMultiple2.Visible = True
        txtMultiple3.Visible = True
        comboAns.Visible = False
        Label8.Visible = True
        Label9.Visible = True
        Label10.Visible = True
    End Sub

    Private Sub loadTopics(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles comboUnit.SelectedIndexChanged
        'Gets the unit selected in the units combo box and calls
        findTopics to load the associated topics to the topics combo box
        Dim unit As String = comboUnit.SelectedItem.ToString
        Call findTopics(unit)
    End Sub
    Sub findTopics(ByVal unit As String)
        'Clears the topics combo box
        comboTopic.Items.Clear()
        'Gets the user directory name by retrieving the environment
        variable "userprofile"
        Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
        If System.IO.File.Exists(userDirectory & "\Benchmark\" & unit
& ".txt") Then
            'Open the file at the user profile directory with the name
            of the selected unit
            Dim allLines() As String =
System.IO.File.ReadAllLines(userDirectory & "\Benchmark\" & unit &
".txt")
            'If the file exists, load existing topics into the combo
            box
            If allLines.Length > 0 Then

```

```

        For i = 0 To allLines.Length - 1
            'Iterate through the lines of the file, reading a
            topic from each line
            comboTopic.Items.Add(allLines(i))
        Next
        comboTopic.Update()
    End If
Else : comboTopic.Items.Add("Unknown topic")
    'If there is an error reading the file, load 'Unknown
topic' into the box
    'The box cannot be left blank according to the validation
rules of the form
End If
comboTopic.SelectedIndex = 0
End Sub

Sub clearQuestion()
    txtQuestion.Clear()
    txtAns.Clear()
    radShortAns.Checked = True
    txtMultiple1.Clear()
    txtMultiple2.Clear()
    txtMultiple3.Clear()
    txtQuestion.Select()
    'Clear all text boxes and reset to the default question type;
short answer
    Me.Size = New Point(436, 440)
    pnlCharacters.Size = New Point(32, 208)
    pnlCharacters.Text = "+"
    pnlButtons.Visible = False
    lblCharacters.Visible = False
    comboAns.Size = New Point(351, 21)
    txtAns.Size = New Point(351, 20)
    txtMultiple1.Size = New Point(351, 20)
    txtMultiple2.Size = New Point(351, 20)
    txtMultiple3.Size = New Point(351, 20)
    btnSaveQuestion.Location = New Point(315, 363)
    Me.MaximumSize = New Point(450, 440)
    'Reset the form to its minimised size with the additional
characters panel closed
    comboRating.SelectedIndex = 0
End Sub

```

```

Private Sub saveQuestion(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnSaveQuestion.Click

```

```

Dim validquestion As Boolean = True
If txtQuestion.Text = "" Then 'No question
    validquestion = False
    MsgBox("Please enter a question.")
ElseIf comboUnit.Text = "" Then 'No unit
    validquestion = False
    MsgBox("Please select a unit.")
ElseIf comboTopic.Text = "" Then 'No topic
    validquestion = False
    MsgBox("Please select a topic.")
ElseIf (radShortAns.Checked = True Or radCalculation.Checked =
True Or radMultipleChoice.Checked = True) And txtAns.Text = "" Or
        (RadTrueFalse.Checked = True And comboAns.Text =
"") Then 'No answer
    validquestion = False
    MsgBox("Please submit an answer.")
ElseIf radCalculation.Checked = True Then 'No T/F answer
    Dim integerTest As Integer
    Try
        integerTest = CInt(txtAns.Text)
    Catch
        validquestion = False
        MsgBox("Numerical answers cannot contain words or
characters.")
    End Try
ElseIf radMultipleChoice.Checked = True And (txtMultiple1.Text =
"" Or txtMultiple2.Text = "" Or txtMultiple3.Text = "") Then
    validquestion = False
    MsgBox("Please submit three incorrect answers.") 'Missing
incorrect answer(s)
End If
'Save question data
If validquestion = True Then
    Call saveQuestion()
    Call clearQuestion()
    editing = False
    Me.Close()
End If
frmHome.lstQuestions.ClearSelected()
End Sub
Sub saveQuestion()
    'Create a new instance of the question class
    Dim currentQuestion As New Question
    If editing = True Then
        'Do not create a new instance of the question class, edit
the existing one

```

```

If questionType = "TF" Then
    'Rewrite the current question
    'Pass the answer as a boolean
    frmHome.updateQuestion(txtQuestion.Text, questionType,
CInt(comboRating.Text), comboAns.Text, txtMultiple1.Text,
txtMultiple2.Text, txtMultiple3.Text, comboUnit.Text, comboTopic.Text)
    Else 'Pass the answer as a string
        frmHome.updateQuestion(txtQuestion.Text, questionType,
CInt(comboRating.Text), txtAns.Text, txtMultiple1.Text,
txtMultiple2.Text, txtMultiple3.Text, comboUnit.Text, comboTopic.Text)
    End If
Else
    currentQuestion.setQID(allquestions.Count)
    currentQuestion.setQText(txtQuestion.Text)
    currentQuestion.setQUnit(comboUnit.Text)
    currentQuestion.setQTopic(comboTopic.Text)
    currentQuestion.setQRating(CInt(comboRating.Text))
    currentQuestion.setQType(questionType)
    If questionType = "TF" Then
        currentQuestion.setQAnswer(comboAns.Text)
    Else : currentQuestion.setQAnswer(txtAns.Text)
    End If
    If questionType = "MC" Then Call
saveMultipleChoiceAnswers(currentQuestion)
    'Save the question just added as a new question
    frmHome.addNewQuestion(currentQuestion)
    frmHome.refreshList()
End If
End Sub
Sub saveMultipleChoiceAnswers(ByRef newquestion As Question)
    newquestion.setIncorrect(txtMultiple1.Text, 0)
    newquestion.setIncorrect(txtMultiple2.Text, 1)
    newquestion.setIncorrect(txtMultiple3.Text, 2)
    newquestion.setQAnswer(txtAns.Text)
End Sub

Sub editQuestion(ByRef editQuestion As Question)
    'Set the editing boolean to true so the form controls don't
refresh
    editing = True
    comboUnit.Items.Clear()
    Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
    If System.IO.File.Exists(userDirectory &
"\Benchmark\Units.txt") Then

```

```

        Dim allLines() As String =
System.IO.File.ReadAllLines(userDirectory & "\Benchmark\Units.txt")
        If allLines.Length > 0 Then
            For i = 0 To allLines.Length - 1
                comboUnit.Items.Add(allLines(i))
            Next
            comboUnit.Update()
        End If
    End If
    'Load the existing question text
    txtQuestion.Text = editQuestion.getQText
    'Try loading the existing units and topics
    'If they are no longer in the system, load 'Unknown unit'
    Try
        comboUnit.SelectedItem = editQuestion.getQUnit
    Catch
        comboUnit.Items.Add("Unknown unit")
        comboUnit.SelectedIndex = comboUnit.Items.Count
    End Try
    Try
        comboTopic.SelectedItem = editQuestion.getQTopic
    Catch
        comboTopic.Items.Add("Unknown topic")
        comboTopic.SelectedIndex = comboTopic.Items.Count
    End Try
    'Select the correct radio button based on question type
    If editQuestion.getQType = "SA" Then
        radShortAns.Select()
        txtAns.Text = editQuestion.getQAnswer
    ElseIf editQuestion.getQType = "TF" Then
        RadTrueFalse.Select()
        comboAns.Text = editQuestion.getQAnswer
    ElseIf editQuestion.getQType = "MC" Then
        radMultipleChoice.Select()
        txtAns.Text = editQuestion.getQAnswer
        txtMultiple1.Text = editQuestion.getIncorrect(0)
        txtMultiple2.Text = editQuestion.getIncorrect(1)
        txtMultiple3.Text = editQuestion.getIncorrect(2)
    ElseIf editQuestion.getQType = "NU" Then
        radCalculation.Select()
        txtAns.Text = editQuestion.getQAnswer
    End If
    'Set the rating
    comboRating.Text = editQuestion.getQRating
End Sub

```

```

    Private Sub toggleSize(ByVal sender As Object, ByVal e As
System.Windows.Forms.MouseEventArgs) Handles pnlCharacters.MouseClick
        If pnlCharacters.Text = "+" Then
            'If the panel title contains the + symbol then it is in
            its minimised position
            'Change the size of the form to contain the expanded
            characters panel
            Me.Size = New Point(580, 440)
            pnlCharacters.Size = New Point(167, 208)
            pnlCharacters.Text = "-"
            pnlButtons.Visible = True
            lblCharacters.Visible = True
            comboAns.Size = New Point(486, 21)
            txtAns.Size = New Point(486, 20)
            txtMultiple1.Size = New Point(486, 20)
            txtMultiple2.Size = New Point(486, 20)
            txtMultiple3.Size = New Point(486, 20)
            btnSaveQuestion.Location = New Point(448, 363)
            Me.MinimumSize = New Point(580, 440)
            'Create nine new instances of the point class to resize:
            '1: the form base
            '2: the panel containing the additional characters
            '3: the true/false answer combo box
            '4: the text field answer box
            '5, 6, 7: the incorrect answer boxes for multiple choice
questions
            '8: the location of the save button
            '9: the new minimum size of the expanded form
        Else
            'If the panel title contains the - symbol then it is in
            its maximised position
            'Change the size of the form to contain the contracted
            characters panel
            Me.Size = New Point(436, 440)
            pnlCharacters.Size = New Point(32, 208)
            pnlCharacters.Text = "+"
            pnlButtons.Visible = False
            lblCharacters.Visible = False
            comboAns.Size = New Point(351, 21)
            txtAns.Size = New Point(351, 20)
            txtMultiple1.Size = New Point(351, 20)
            txtMultiple2.Size = New Point(351, 20)
            txtMultiple3.Size = New Point(351, 20)
            btnSaveQuestion.Location = New Point(315, 363)
            Me.MaximumSize = New Point(450, 440)

```

```

'Create nine new instances of the point class to resize:
'1: the form base
'2: the panel containing the additional characters
'3: the true/false answer combo box
'4: the text field answer box
'5, 6, 7: the incorrect answer boxes for multiple choice
questions
'8: the location of the save button
'9: the new minimum size of the contracted form
End If
End Sub

'Call the insertcharacter subroutine and pass the relevant
character to be inserted into the question text
Private Sub btnα_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnα.Click
    Call insertCharacter("α")
End Sub
Private Sub btnβ_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnβ.Click
    Call insertCharacter("β")
End Sub
Private Sub btnγ_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnγ.Click
    Call insertCharacter("γ")
End Sub
Private Sub btnΔ_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnΔ.Click
    Call insertCharacter("Δ")
End Sub
Private Sub btn_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btn.Click
    Call insertCharacter("δ")
End Sub
Private Sub btnθ_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnθ.Click
    Call insertCharacter("θ")
End Sub
Private Sub btnθ2_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnθ2.Click
    Call insertCharacter("θ")
End Sub
Private Sub btnλ_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnλ.Click
    Call insertCharacter("λ")
End Sub

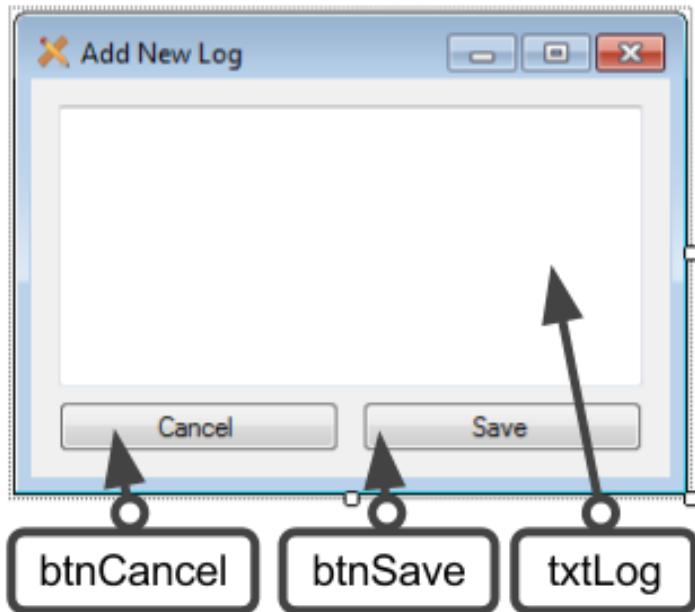
```

```
Private Sub btnμ_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnμ.Click
    Call insertCharacter("μ")
End Sub
Private Sub btnv_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnv.Click
    Call insertCharacter("v")
End Sub
Private Sub btnΣ_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnΣ.Click
    Call insertCharacter("Σ")
End Sub
Private Sub btnσ2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnσ2.Click
    Call insertCharacter("σ")
End Sub
Private Sub btn∅_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btn∅.Click
    Call insertCharacter("∅")
End Sub
Private Sub btnφ2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnφ2.Click
    Call insertCharacter("φ")
End Sub
Private Sub btnΩ_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnΩ.Click
    Call insertCharacter("Ω")
End Sub
Private Sub btnω2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnω2.Click
    Call insertCharacter("ω")
End Sub
Private Sub btnDegrees_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnDegrees.Click
    Call insertCharacter("°")
End Sub
Private Sub btnf_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnf.Click
    Call insertCharacter("f")
End Sub
Private Sub btnPlusMinus_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnPlusMinus.Click
    Call insertCharacter("±")
End Sub
Private Sub btnAngle_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnAngle.Click
```

```
    Call insertCharacter("∠")
End Sub
Private Sub btnLessEqual_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnLessEqual.Click
    Call insertCharacter("≤")
End Sub
Private Sub btnMoreEqual_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles btnMoreEqual.Click
    Call insertCharacter("≥")
End Sub
Private Sub btnApprox_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnApprox.Click
    Call insertCharacter("≈")
End Sub
Private Sub btnπ_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnπ.Click
    Call insertCharacter("π")
End Sub
Private Sub btnNotEqual_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnNotEqual.Click
    Call insertCharacter("≠")
End Sub
Sub insertCharacter(ByVal character As String)
    'Update the question text field at the position of the caret
    'with the character passed to it
    txtQuestion.Text =
    txtQuestion.Text.Insert(txtQuestion.SelectionStart, character)
End Sub
End Class
```

### frmAddLog

Handles the input of new class log data and the editing of existing class logs in the system.



```
Public Class frmAddLog
```

```
    Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        'Sets the properties determining whether the user can
minimise or maximise the form
        'Hides the form's control bar
        Me.MinimizeBox = False
        Me.MaximizeBox = False
        Me.ControlBox = False
        Try
            'Loads the log of the class selected in the logs form to
the text box
            txtLog.Text =
frmClassLogs.allClasses(frmClassLogs.lstAllClasses.SelectedIndex).getG
roupLog
        Catch
            Me.Close()
        End Try
    End Sub

    Private Sub cancelChanges(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles btnCancel.Click
        If txtLog.Text <> "This class doesn't have a log yet." Then
```

```

        'If the contents of the text box has changed since
loading, notify the user they will lose changes
        Dim result As MsgBoxResult = MsgBox("You will lose unsaved
changes. Are you sure you want to cancel?", MsgBoxStyle.YesNo)
        If result = MsgBoxResult.Yes Then
            Me.Close()
        End If
        'If the user does not choose yes on the save changes
dialog, leave the form open
        Else : Me.Close()
        End If
    End Sub

    Private Sub handleReturn(ByVal sender As Object, ByVal e As
System.Windows.Forms.KeyPressEventArgs) Handles txtLog.KeyPress
        'If the user presses the return key, set the KeyPressEvent to
handled so the return is not implemented
        'This is to stop the user using the return key in logs
        If e.KeyChar = Chr(Keys.Return) Then e.Handled = True
    End Sub

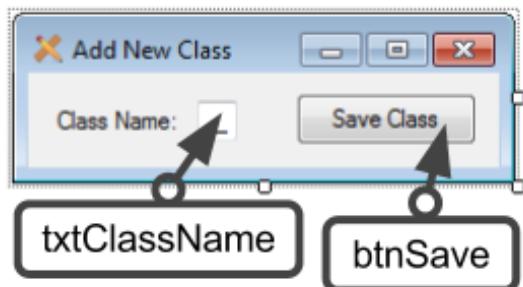
    Private Sub btnSave_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnSave.Click
        If txtLog.Text <> "" And Len(txtLog.Text) <= 500 Then
            'If the log is not empty and not longer than 500
characters
            Dim log As String = txtLog.Text
            frmClassLogs.addLog(log)
            'Call the addLog subroutine, passing the contents of the
log text box
            txtLog.Clear()
            'Clear the text box ready for the next form loading event
            Me.Close()
        ElseIf Len(txtLog.Text) > 500 Then
            MsgBox("You cannot save a log more than 500 characters
long.")
            'Notify the user that their entry was too long
        Else
            MsgBox("You cannot save a blank log.")
            'Notify the user that the field cannot be left blank
        End If
        txtLog.Select()
    End Sub

End Class

```

### frmAddNewClass

Handles the input and validation of classes being added to the system.



```

Public Class frmAddNewClass

    Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        'Sets the properties determining whether the user can
minimise or maximise the form
        Me.MinimizeBox = False
        Me.MaximizeBox = False
    End Sub

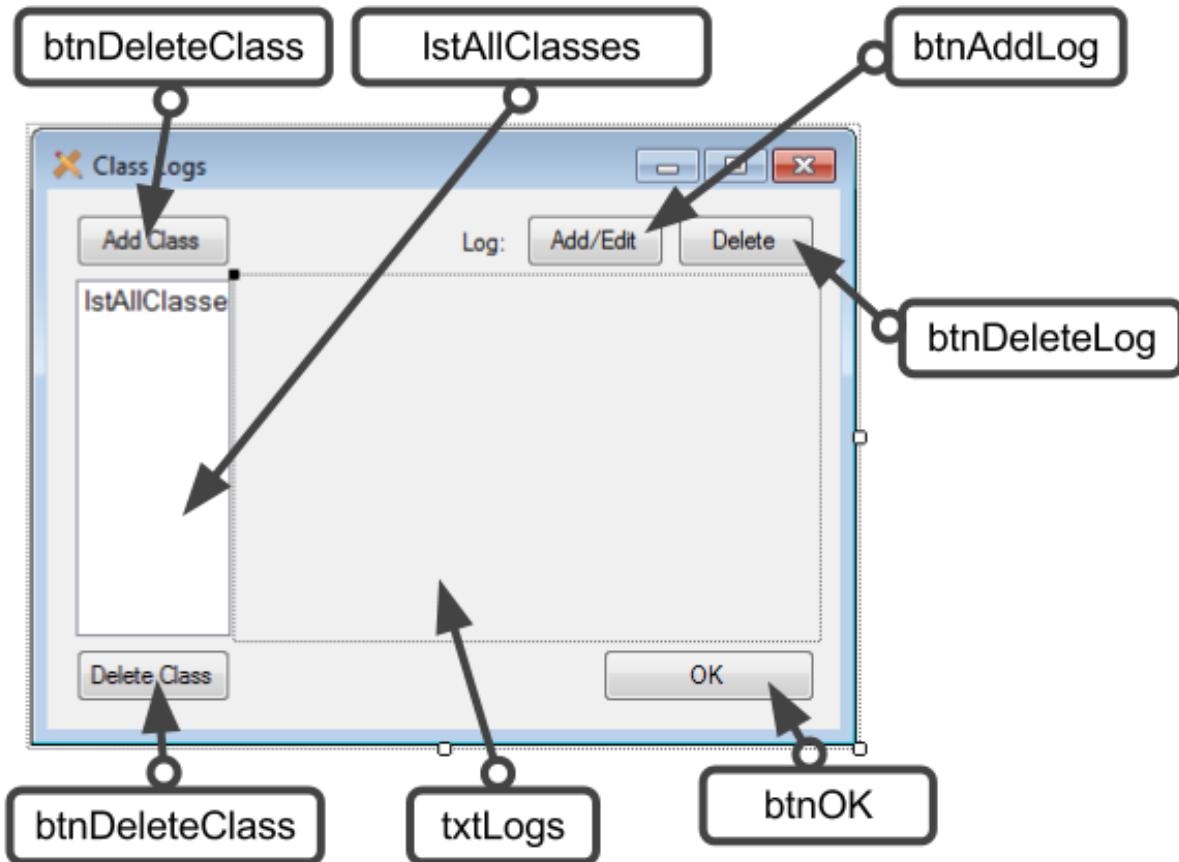
    Private Sub saveClass(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnSave.Click
        If txtClassName.Text <> "" Then
            'If the user has not left the class name text field blank
            'Create a new instance of the group class
            Dim newclass As New Group
            newclass.setGroupName(txtClassName.Text)
            newclass.setGroupLog("This class doesn't have a log yet.")
            'Set the group's name and log
            frmClassLogs.allClasses.Add(newclass)
            'Add the instantiated group into the allclasses system
collection
            frmClassLogs.refreshLog()
            'Refresh the logs display on the class logs form
            txtClassName.Text = ""
            txtClassName.Select()
            'Reset the form controls
            Me.Close()
        Else : MsgBox("Please enter a class name.")
        End If
    End Sub

End Class

```

### frmClassLogs

Handles the displaying of all classes and logs in the system, links to all other class log forms.



```
Public Class frmClassLogs
```

```
'Creates a new instance of collections of groups to store all
physics groups in the system
Public allClasses As New
System.Collections.ObjectModel.Collection(Of Group)

Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
    'Sets the properties which determine whether the user can
maximise and minimise the form
    Me.MinimizeBox = False
    Me.MaximizeBox = False
    'Calls the importlogs subroutine to populate the allclasses
collection
    Call importLogs()
End Sub
Private Sub closeForm(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnOK.Click
```

```

        'Close the form
        Me.Close()
End Sub

Function importLogs()
    'Gets the user directory name by retrieving the environment
variable "userprofile"
    Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
    If System.IO.File.Exists(userDirectory &
"\Benchmark\Logs.txt") Then
        'If the file exists, load existing classes
        Dim allLines() As String =
System.IO.File.ReadAllLines(userDirectory & "\Benchmark\Logs.txt")
        If allLines.Length > 0 Then
            For i = 0 To allLines.Length - 1 Step 2
                'One group is read every two lines
                Dim savedClass As New Group
                'Create a runtime instance of the group class and
add data from the subsequent lines
                savedClass.setGroupName(allLines(i))
                savedClass.setGroupLog(allLines(i + 1))
                allClasses.Add(savedClass)
                'Add the imported class to the allclasses
collection
                Next
                lstAllClasses.Items.Clear()
                Call refreshLog()
                'Refresh the class list to update it from the
collection
            End If
        End If
    End Function
Sub backupLogs()
    'Gets the user directory name by retrieving the environment
variable "userprofile"
    Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
    If System.IO.File.Exists(userDirectory &
"\Benchmark\Logs.txt") Then System.IO.File.Delete(userDirectory &
"\Benchmark\Logs.txt")
        'Clear the previous backup file and rewrite it from the
allclasses collection
        Dim backup As New System.IO.StreamWriter(userDirectory &
"\Benchmark\Logs.txt")

```

```

'Create a new instance of the streamwriter class
For Each item In allClasses
    'For every group in the system, call the backupLog
function to write it to the file
    backup.Write(backupLog(item))
Next
backup.Close()
'Close the streamwriter
End Sub
Function backupLog(ByVal g As Group)
    'Return data held on a group to be written to the file
    backupLog = g.getGroupName & vbCrLf & g.getLog &
vbCrLf
End Function

Sub refreshLog()
    lstAllClasses.Items.Clear()
    'Clear the classes list and repopulate it from the allclasses
collection
    For Each item In allClasses
        lstAllClasses.Items.Add(item.getGroupName)
    Next
    If allClasses.Count = 0 Then txtLogs.Text = ""
    Try
        lstAllClasses.ClearSelected()
        lstAllClasses.SelectedIndex = 0
        'Try selecting the first element in the class list
        'Catch the exception which will be thrown if allclasses is
empty
        Catch
    End Try
    Call backupLogs()
End Sub

Private Sub addClass(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnAddClass.Click
    'Show the add class dialog
    frmAddNewClass.ShowDialog()
End Sub
Private Sub deleteClass(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnDeleteClass.Click
    If lstAllClasses.SelectedIndex > -1 Then
        'If there is a group selected

```

```

        Dim result As MsgBoxResult = MsgBox("Are you sure you want
to delete this class?", MsgBoxStyle.YesNo)
        'Confirm the deletion of the group with the user
        If result = MsgBoxResult.Yes Then
            allClasses.RemoveAt(lstAllClasses.SelectedIndex)
            'Remove the group from the allclasses collection
            Call refreshLog()
            'Refresh the list display of the groups
        End If
        Else : MsgBox("Please select a class.")
    End If
End Sub

```

```

Private Sub addLog(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnAddLog.Click
    If lstAllClasses.SelectedIndex > -1 Then
        frmAddLog.ShowDialog()
        'Open the addlog form if there is a group selected
    Else : MsgBox("Please select a class.")
    End If
End Sub
Sub addLog(ByVal log)
    allClasses(lstAllClasses.SelectedIndex).setGroupLog(log)
    'Set the log of the selected group to the log passed to it
    Call refreshLog()
    'Refresh the group list with the updated log
End Sub
Private Sub deleteLog(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnDeleteLog.Click
    If lstAllClasses.SelectedIndex > -1 Then
        'If there is a group selected, confirm deletion of the log
        with the user
        Dim result As MsgBoxResult = MsgBox("Are you sure you want
        to clear the current log?", MsgBoxStyle.YesNo)
        If result = MsgBoxResult.Yes Then
            'Set the log back to the default text
            allClasses(lstAllClasses.SelectedIndex).setGroupLog("This class
            doesn't have a log yet.")
            Call refreshLog()
            'Refresh the group list with the updated log
        End If
        Else : MsgBox("Please select a class.")
    End If
End Sub

```

```

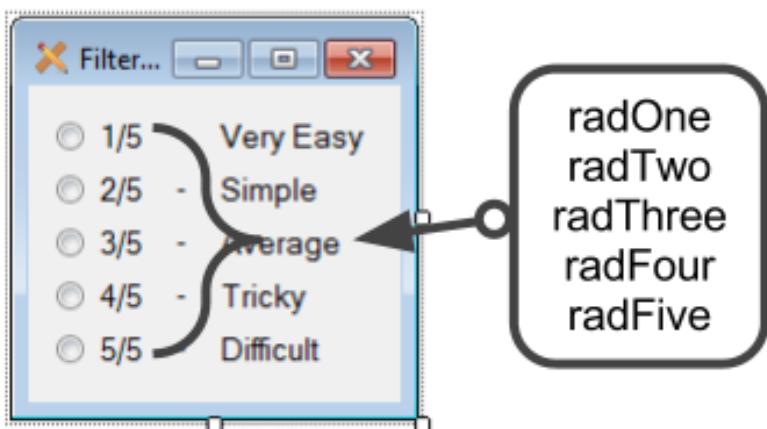
    Private Sub logPreview(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles lstAllClasses.SelectedIndexChanged
        txtLogs.Text =
allClasses(lstAllClasses.SelectedIndex).getGroupLog
        'Show the log of the currently selected group in the panel on
the right of the form
    End Sub
End Class

```

---

### frmFilterDifficulty

Handles the input of difficulty ratings to filter questions.



### Public Class frmFilterDifficulty

```

    Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        'Sets the properties which determine whether the user can
maximise or minimise the form
        Me.MinimizeBox = False
        Me.MaximizeBox = False
        radThree.Select()
        'Select the default difficulty radio button to filter by
    End Sub

    Private Sub oneSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radOne.CheckedChanged
        frmHome.filterDifficulty(1)
        'Pass 1 to the filterdifficulty routine on the home form
    End Sub

```

```

    Private Sub twoSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radTwo.CheckedChanged
        frmHome.filterDifficulty(2)
        'Pass 2 to the filterdifficulty routine on the home form
    End Sub

    Private Sub threeSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radThree.CheckedChanged
        frmHome.filterDifficulty(3)
        'Pass 3 to the filterdifficulty routine on the home form
    End Sub

    Private Sub fourSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radFour.CheckedChanged
        frmHome.filterDifficulty(4)
        'Pass 4 to the filterdifficulty routine on the home form
    End Sub

    Private Sub fiveSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radFive.CheckedChanged
        frmHome.filterDifficulty(5)
        'Pass 5 to the filterdifficulty routine on the home form
    End Sub

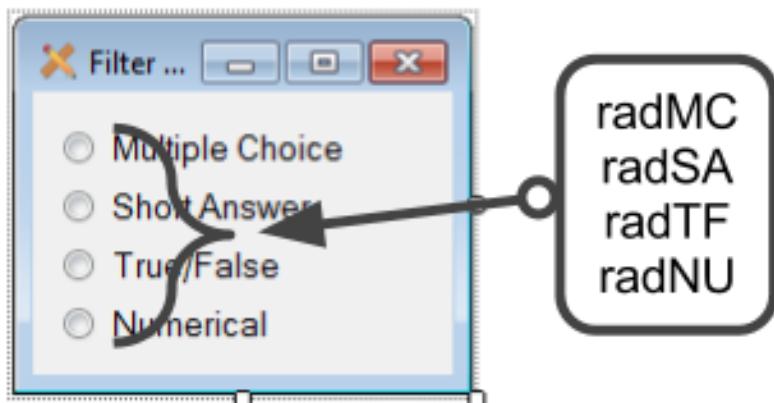
End Class

```

---

### frmFilterType

Handles the input of question types to filter questions.



```

Public Class frmFilterType

    Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load

```

```

    'Sets the properties which determine whether the user can
    maximise or minimise the form
    Me.MinimizeBox = False
    Me.MaximizeBox = False
    radMC.Select()
    'Select the default type radio button to filter by
End Sub

Private Sub MCSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radMC.CheckedChanged
    frmHome.filterType("MC")
    'Pass "MC" to the filtertype routine on the home form
End Sub

Private Sub SASelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radSA.CheckedChanged
    frmHome.filterType("SA")
    'Pass "SA" to the filtertype routine on the home form
End Sub

Private Sub TFSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radTF.CheckedChanged
    frmHome.filterType("TF")
    'Pass "TF" to the filtertype routine on the home form
End Sub

Private Sub NUSelected(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles radNU.CheckedChanged
    frmHome.filterType("NU")
    'Pass "NU" to the filtertype routine on the home form
End Sub

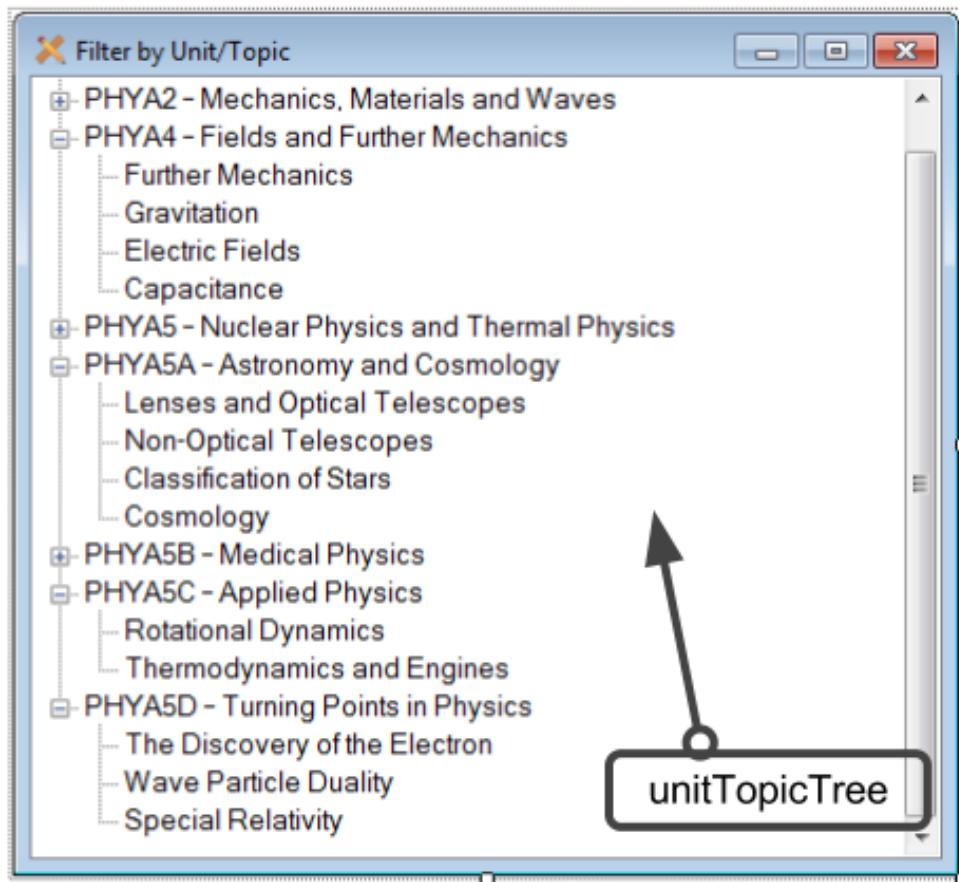
End Class

```

---

## frmFilterUnitTopic

Handles the input of units and topics to filter questions.



```
Public Class frmFilterUnitTopic
```

```
    Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        Me.MinimizeBox = False
        Me.MaximizeBox = False
        'Sets the properties which determine whether the user can
maximise or minimise the form
        unitTopicTree.Nodes.Clear()
        'Clear the data from the tree
        'Gets the user directory name by retrieving the environment
variable "userprofile"
        Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
        If System.IO.File.Exists(userDirectory &
"\Benchmark\Units.txt") Then
            'If the file exists, load existing units into an array
```

```

        Dim allLines() As String =
System.IO.File.ReadAllLines(userDirectory & "\Benchmark\Units.txt")
        If allLines.Length > 0 Then
            For i = 0 To allLines.Length - 1
                'For every unit read, add the unit as a new node
to the tree
                Dim parentNode As TreeNode =
unitTopicTree.Nodes.Add(allLines(i))
                Try
                    Dim topicLines() As String =
System.IO.File.ReadAllLines(userDirectory & "\Benchmark\" &
allLines(i) & ".txt")
                    'Read the contents of the file with the same
name as the unit into an array
                    If topicLines.Length > 0 Then
                        For j = 0 To topicLines.Length - 1
                            parentNode.Nodes.Add(topicLines(j))
                            'For every topic within the units file
read, add the topic as a child node
                        Next
                    End If
                    Catch : parentNode.Nodes.Add("Unknown topic")
                    'If the topics file isn't found, catch the
exception
                End Try
                Next
                unitTopicTree.Update()
                'Update the tree with the new units and topics
            End If
        Else : unitTopicTree.Nodes.Add("Unknown unit")
        'If the units file isn't found, catch the exception
    End If
    unitTopicTree.CollapseAll()
End Sub

```

```

Private Sub nodeChanged(ByVal sender As System.Object, ByVal e As
System.Windows.Forms.TreeViewEventArgs) Handles
unitTopicTree.AfterSelect
    'Declare a variable based on the index of the selected node in
a tree
    'Units (parent nodes) will have a treeIndex of 1
    'Topics (child nodes) will have a treeIndex of 2
    Dim treeIndex As Integer = unitTopicTree.SelectedNode.Level +
1
    Dim nodeTitle As String = unitTopicTree.SelectedNode.Text

```

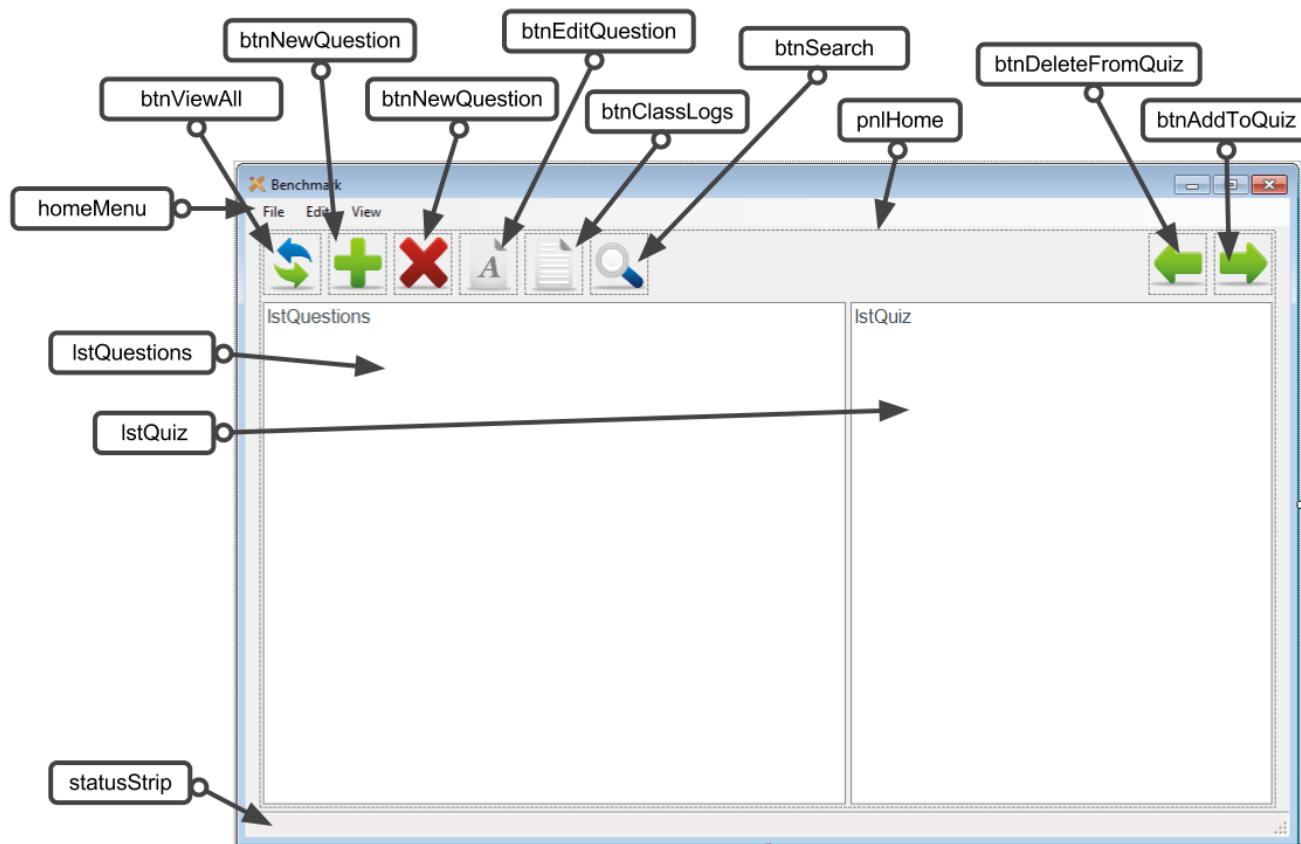
```
'Call the filterunittopic subroutine, passing the index and
title of the node
    frmHome.filterUnitTopic(treeIndex, nodeTitle)
End Sub

End Class
```

---

### frmHome

The main form of the system, displays all questions in the system and the current quiz.



```
Public Class frmHome
```

```
'Creates a new instance of collections of questions to store all
questions in the system
Dim allQuestions As New
System.Collections.ObjectModel.Collection(Of Question)
'Creates a new instance of collections of questions to store all
questions in the current quiz
Dim newQuiz As New System.Collections.ObjectModel.Collection(Of
Question)
```

```

    Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        'Startup routines
        'Sets the tooltips for the shortcut bar
        'Calls the import subroutine
        'Calls the count routine to display the number of questions in
the system
        Call setToolTips()
        Call importAllQuestions()
        Call countLists()
        Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
        System.IO.Directory.CreateDirectory(userDirectory &
"\Benchmark")
        'Create a folder in the user profile directory to save all
system data
        'Create will not affect the directory if it already exists
        'The following code will only be executed if no 'units' text
file exists
        'i.e. the default units have not been changed because the
system has never been run or the file has been deleted.
        If System.IO.File.Exists(userDirectory &
"\Benchmark\Units.txt") = False Then
            'Write a text file with a list of the default units
            Dim defaultUnitSetup As New
System.IO.StreamWriter(userDirectory & "\Benchmark\Units.txt")
            defaultUnitSetup.WriteLine("PHYA1 - Particles, Quantum
Phenomena and Electricity" & vbCrLf &
                                         "PHYA2 - Mechanics, Materials and
Waves" & vbCrLf &
                                         "PHYA4 - Fields and Further
Mechanics" & vbCrLf &
                                         "PHYA5 - Nuclear Physics and
Thermal Physics" & vbCrLf &
                                         "PHYA5A - Astronomy and Cosmology"
& vbCrLf &
                                         "PHYA5B - Medical Physics" &
                                         "PHYA5C - Applied Physics" &
                                         "PHYA5D - Turning Points in
Physics")
            defaultUnitSetup.Close()
            'Close the streamwriter and write text files with topic
lists for each unit in the units text file

```

```

        defaultUnitSetup = New
System.IO.StreamWriter(userDirectory & "\Benchmark\PHYA1 - Particles,
Quantum Phenomena and Electricity.txt")
        defaultUnitSetup.Write("Particles and Radiation" &
vbNewLine &
                "Electromagnetic Radiation and
Quantum Phenomena" & vbNewLine &
                "Current Electricity")
        defaultUnitSetup.Close()
        defaultUnitSetup = New
System.IO.StreamWriter(userDirectory & "\Benchmark\PHYA2 - Mechanics,
Materials and Waves.txt")
        defaultUnitSetup.Write("Mechanics" & vbNewLine &
                "Materials" & vbNewLine &
                "Waves")
        defaultUnitSetup.Close()
        defaultUnitSetup = New
System.IO.StreamWriter(userDirectory & "\Benchmark\PHYA4 - Fields and
Further Mechanics.txt")
        defaultUnitSetup.Write("Further Mechanics" & vbNewLine &
                "Gravitation" & vbNewLine &
                "Electric Fields" & vbNewLine &
                "Capacitance")
        defaultUnitSetup.Close()
        defaultUnitSetup = New
System.IO.StreamWriter(userDirectory & "\Benchmark\PHYA5 - Nuclear
Physics and Thermal Physics.txt")
        defaultUnitSetup.Write("Radioactivity" & vbNewLine &
                "Nuclear Energy" & vbNewLine &
                "Thermal Physics")
        defaultUnitSetup.Close()
        defaultUnitSetup = New
System.IO.StreamWriter(userDirectory & "\Benchmark\PHYA5A - Astronomy
and Cosmology.txt")
        defaultUnitSetup.Write("Lenses and Optical Telescopes" &
vbNewLine &
                "Non-Optical Telescopes" &
vbNewLine &
                "Classification of Stars" &
vbNewLine &
                "Cosmology")
        defaultUnitSetup.Close()
        defaultUnitSetup = New
System.IO.StreamWriter(userDirectory & "\Benchmark\PHYA5B - Medical
Physics.txt")
        defaultUnitSetup.Write("Physics of the Eye" & vbNewLine &

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    "Physics of the Ear" & vbCrLf &
    "Biological Measurement" &
vbCrLf &
    "Non-Ionising Imaging" & vbCrLf
&
    "X-Ray Imaging")
    defaultUnitSetup.Close()
    defaultUnitSetup = New
System.IO.StreamWriter(userDirectory & "\Benchmark\PHYA5C – Applied
Physics.txt")
    defaultUnitSetup.WriteLine("Rotational Dynamics" & vbCrLf &
    "Thermodynamics and Engines")
    defaultUnitSetup.Close()
    defaultUnitSetup = New
System.IO.StreamWriter(userDirectory & "\Benchmark\PHYA5D - Turning
Points in Physics.txt")
    defaultUnitSetup.WriteLine("The Discovery of the Electron" &
vbCrLf &
    "Wave Particle Duality" & vbCrLf
&
    "Special Relativity")
    defaultUnitSetup.Close()
End If
End Sub
Sub setToolTips()
    'Sets the tooltips for all the shortcut icons on the home form
    iconsToolTip.SetToolTip(btnViewAll, "View All Questions")
    iconsToolTip.SetToolTip(btnNewQuestion, "Add New Question")
    iconsToolTip.SetToolTip(btnDeleteQuestion, "Delete Question")
    iconsToolTip.SetToolTip(btnEditQuestion, "Edit Question")
    iconsToolTip.SetToolTip(btnSearch, "Search Questions")
    iconsToolTip.SetToolTip(btnClassLogs, "View Class Logs")
    iconsToolTip.SetToolTip(btnAddToQuiz, "Add Question To Quiz")
    iconsToolTip.SetToolTip(btnDeleteFromQuiz, "Remove Question
From Quiz")
End Sub
Function importAllQuestions()
    'Gets the user directory name by retrieving the environment
variable "userprofile"
    Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
    If System.IO.File.Exists(userDirectory &
"\Benchmark\Questions.txt") Then
        'If the file exists, load existing questions into an array

```

```

        Dim allLines() As String =
System.IO.File.ReadAllLines(userDirectory &
"\Benchmark\Questions.txt")
        If allLines.Length > 0 Then
            Dim count As Integer = 0
            For i = 0 To allLines.Length - 8 Step 9
                'One question is read every nine lines
                Dim savedQuestion As New Question
                'Create a runtime instance of the question class
and add data from the subsequent lines
                savedQuestion.setQID(count + 1)
                'Count is zero-based but the list index should
begin at 1
                savedQuestion.setQText(allLines(i))
                savedQuestion.setQType(allLines(i + 1))
                savedQuestion.setQAnswer(allLines(i + 2))
                If savedQuestion.getQType = "MC" Then
                    'Read incorrect answers for multiple choice
questions
                    savedQuestion.setIncorrect(allLines(i + 3), 0)
                    savedQuestion.setIncorrect(allLines(i + 4), 1)
                    savedQuestion.setIncorrect(allLines(i + 5), 2)
                End If
                savedQuestion.setQUnit(allLines(i + 6))
                savedQuestion.setQTopic(allLines(i + 7))
                savedQuestion.setQRating(allLines(i + 8))
                count = count + 1
                allQuestions.Add(savedQuestion)
                'Add the imported question into allQuestions
collection
                Next
                Call refreshList()
                'Refresh the question list and recount the lists
            End If
        Else : MsgBox("Welcome to Benchmark. You haven't added any
questions yet.")
            ' if the files don't exist, this is the first time the
software has been used.
        End If
    End Function
    Sub backupAllQuestions()
        'Gets the user directory name by retrieving the environment
variable "userprofile"
        Dim userDirectory As String =
Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
```

```

    If System.IO.File.Exists(userDirectory &
"\Benchmark\Questions.txt") Then System.IO.File.Delete(userDirectory &
"\Benchmark\Questions.txt")
        'Clear the previous backup and rewrite it with the contents of
allquestions
        Dim backup As New System.IO.StreamWriter(userDirectory &
"\Benchmark\Questions.txt")
        'Create a new instance of the streamwriter class
        For i = 0 To allQuestions.Count - 1
            'For every question in the system, call the backupQuestion
function to write it to the file
            backup.WriteLine(backupQuestion(allQuestions(i)))
        Next
        backup.Close()
        'Close the streamwriter
    End Sub
    Function backupQuestion(ByVal q As Question)
        'Return data held on a question to be written to the file
        backupQuestion = q.getQText & vbCrLf & q.getQType &
vbCrLf & q.getQAnswer &
vbCrLf & q.getIncorrect(0) & vbCrLf &
q.getIncorrect(1) & vbCrLf &
q.getIncorrect(2) & vbCrLf & q.getQUnit & vbCrLf &
q.getQTopic & vbCrLf & q.getQRating & vbCrLf
    End Function

Sub refreshList() Handles btnViewAll.Click, menuViewAll.Click
    'Removes all question filters currently applied and updates
the question list
    If allQuestions.Count > 0 Then
        'If there are saved questions
        lstQuestions.Items.Clear()
        For i = 0 To allQuestions.Count - 1
            'For every question: re-index and add to the list
            allQuestions(i).setQID(i + 1)
            lstQuestions.Items.Add(allQuestions(i).getQID & " " &
vbTab & allQuestions(i).getQText & " (" & allQuestions(i).getQAnswer &
") [" & allQuestions(i).getQTopic & ", " & allQuestions(i).getQRating
& "]")
        Next
        Call backupAllQuestions()
        lstQuiz.ClearSelected()
        lstQuestions.ClearSelected()
        'Backup the questions and deselect items in both lists
    Else : Exit Sub
End Sub

```

```

        End If
        Call countLists()
        'Count questions
    End Sub
    Sub refreshQuiz()
        'Clears and refreshes the quiz list when it has changed, in
        the event of questions being added, deleted or edited
        lstQuiz.Items.Clear()
        For i = 0 To newQuiz.Count - 1
            lstQuiz.Items.Add(newQuiz(i).getQText & " (" &
newQuiz(i).getQAnswer & ")")
        Next
        Call countLists()
        'Count questions
    End Sub
    Sub countLists()
        'Updates the count toolbar at the bottom of the form by
        counting the question and quiz lists
        questionStatusLabel.Text = "Viewing " &
lstQuestions.Items.Count & " questions"
        quizStatusLabel.Text = "- Quiz contains " &
lstQuiz.Items.Count & " questions"
    End Sub

    Private Sub addNewQuestion(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles btnNewQuestion.Click,
menuNewQuestion.Click
        'Resets fields on the form and opens it as a dialog
        frmAddEditQuestion.clearQuestion()
        frmAddEditQuestion.ShowDialog()
    End Sub
    Sub addNewQuestion(ByVal newquestion As Question)
        'Add the passed question to the allQuestions collection
        allQuestions.Add(newquestion)
        Call refreshList()
    End Sub
    Private Sub editQuestion(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnEditQuestion.Click,
menuEditQuestion.Click
        Try
            If lstQuestions.SelectedIndex > -1 Then
                'If there is a question selected
                'Get the question index from the list text
                Dim line As String =
lstQuestions.SelectedItem.ToString

```

```

        Dim idIndex As Integer = CInt(line.Substring(0,
line.IndexOf(" "))) - 1
            'Edit the question with the index of the selected list
item
            'Pass the question identified from the index to
frmEditQuestion and open the form
            frmAddEditQuestion.editQuestion(allQuestions(idIndex))
            frmAddEditQuestion.ShowDialog()
            'Otherwise prompt the user to select a question
Else : MsgBox("Please select a question.")
End If
Catch
End Try
End Sub
Sub updateQuestion(ByVal qText, ByVal qtype, ByVal qRating, ByVal
qAns, ByVal qInc1, ByVal qInc2, ByVal qInc3, ByVal qUnit, ByVal
qTopic)
    Dim questionIndex As Integer = lstQuestions.SelectedIndex
    'If editing, the index of the selected question will not have
changed from before frmEditQuestion was opened
    'Update the existing question at the specified index in
allQuestions with the new data passed by frmEditQuestion
    allQuestions(questionIndex).setQText(qText)
    allQuestions(questionIndex).setQType(qtype)
    allQuestions(questionIndex).setQRating(qRating)
    allQuestions(questionIndex).setQAnswer(qAns)
    If allQuestions(questionIndex).getQType = "MC" Then
        allQuestions(questionIndex).setIncorrect(qInc1, 0)
        allQuestions(questionIndex).setIncorrect(qInc2, 1)
        allQuestions(questionIndex).setIncorrect(qInc3, 2)
    End If
    allQuestions(questionIndex).setQUnit(qUnit)
    allQuestions(questionIndex).setQTopic(qTopic)
    'Update the question and quiz lists to display the current
question data
    Call refreshList()
    Call refreshQuiz()
End Sub
Sub deleteQuestion() Handles btnDeleteQuestion.Click,
menuDeleteQuestion.Click
    Dim qDelete As Question
    'Create a new instance of the question class
    Try
        'If there is a question selected
        'Get the question index from the list text
        Dim line As String = lstQuestions.SelectedItem.ToString

```

```

        Dim idIndex As Integer = CInt(line.Substring(0,
line.IndexOf(" "))) - 1
        Dim quizIndex As Integer
refreshList()
'Remove all filters from the question list
If idIndex > -1 Then
    Dim result As MsgBoxResult = MsgBox("Are you sure you
want delete this question?", MsgBoxStyle.YesNo) 'confirm deletion
    'Ask the user to confirm deletion
    If result = MsgBoxResult.Yes Then
        qDelete = allQuestions.Item(idIndex)
        'Assign qDelete the question data from the
selected question in allQuestions
        If alreadyInQuiz(qDelete) Then
            quizIndex = newQuiz.IndexOf(qDelete)
            lstQuiz.Items.RemoveAt(quizIndex)
            newQuiz.Remove(qDelete)
            'If the question is found in the quiz, remove
it from there as well
            MsgBox("Question has also been removed from
current quiz.")
        End If
        lstQuestions.Items.RemoveAt(idIndex)
        allQuestions.Remove(qDelete)
        'Remove the question from the allquestions
collection
        Call refreshList()
    End If
    Else : MsgBox("Please select a question.")
    End If
Catch
End Try
End Sub

```

```

Private Sub searchQuestions(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles btnSearch.Click, menuSearch.Click
    'Load the search form
    frmTextSearch.ShowDialog()
End Sub
Sub searchQuestions(ByVal searchTerm As String)
    Dim found As Boolean
    lstQuestions.Items.Clear()
    'Clear the question list
    For i = 0 To allQuestions.Count - 1
        'Execute for the index of every question in the system

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        If
LCase(allQuestions.ElementAt(i).getQText).contains(LCase(searchTerm))
Then
    found = True
    'Add each matching question to the question list
    lstQuestions.Items.Add(allQuestions(i).getQID & " " &
vbTab & allQuestions(i).getQText & " (" & allQuestions(i).getQAnswer &
") [" & allQuestions(i).getQTopic & ", " & allQuestions(i).getQRating
& "]")
    End If
Next
Call countLists()
'Counts the search results
If found = False Then MsgBox("No questions found.")
'Notify the user if no questions matched the search term
End Sub
Private Sub filterUnitTopic(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles menuFilterUnitTopic.Click
    'Show filter form
    frmFilterUnitTopic.ShowDialog()
End Sub
Sub filterUnitTopic(ByVal treeIndex, ByVal nodeTitle)
    If treeIndex = 1 Then
        'Indexes of 1 indicate the node was a unit
        lstQuestions.Items.Clear()
        'Clear the question list
        For i = 0 To allQuestions.Count - 1
            'Search every question in the system for matching
units
                If allQuestions.ElementAt(i).getQUnit = nodeTitle Then
                    lstQuestions.Items.Add(allQuestions(i).getQID & "
" & vbTab & allQuestions(i).getQText & " (" &
allQuestions(i).getQAnswer & ") [" & allQuestions(i).getQTopic & ", "
& allQuestions(i).getQRating & "]")
                End If
            Next
            Call countLists()
        ElseIf treeIndex = 2 Then
            'Indexes of 2 indicate the node was a topic
            lstQuestions.Items.Clear()
            For i = 0 To allQuestions.Count - 1
                'Search every question in the system for matching
topics
                    If allQuestions.ElementAt(i).getQTopic = nodeTitle
Then

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        1stQuestions.Items.Add(allQuestions(i).getQID & "
" & vbTab & allQuestions(i).getQText & " (" &
allQuestions(i).getQAnswer & ") [" & allQuestions(i).getQTopic & ", "
& allQuestions(i).getQRating & "]")
    End If
Next
Call countLists()
'Count the search results
End If
End Sub
Private Sub filterDifficulty(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles menuFilterDifficulty.Click
    'Show filter form
    frmFilterDifficulty.ShowDialog()
End Sub
Sub filterDifficulty(ByVal rating)
    1stQuestions.Items.Clear()
    'Clear the question list
    For i = 0 To allQuestions.Count - 1
        If allQuestions.ElementAt(i).getQRating = rating Then
            'Search every question in the system for matching
difficulty ratings
            1stQuestions.Items.Add(allQuestions(i).getQID & " " &
vbTab & allQuestions(i).getQText & " (" & allQuestions(i).getQAnswer &
") [" & allQuestions(i).getQTopic & ", " & allQuestions(i).getQRating
& "]")
        End If
    Next
    Call countLists()
    'Count the search results
End Sub
Private Sub filterType(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles menuFilterType.Click
    'Show filter form
    frmFilterType.ShowDialog()
End Sub
Sub filterType(ByVal type)
    1stQuestions.Items.Clear()
    'Clear the question list
    For i = 0 To allQuestions.Count - 1
        If allQuestions(i).getQType = type Then
            'Search every question in the system for matching
question types
            1stQuestions.Items.Add(allQuestions(i).getQID & " " &
vbTab & allQuestions(i).getQText & " (" & allQuestions(i).getQAnswer &
")
        End If
    Next
    Call countLists()
    'Count the search results
End Sub

```

```

") [" & allQuestions(i).getQTopic & ", " & allQuestions(i).getQRating
& "]")
      End If
    Next
    Call countLists()
End Sub
Private Sub alphabetSort(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles SortQuestionsAlphabetically.Click
  If allQuestions.Count > 0 Then
    'Unless there are questions in the system, the algorithm
    won't run
    Dim questionList(allQuestions.Count - 1, 1) As String
    'Creates a 2-D array the same size as the allquestions
    system collection
    For i = 0 To allQuestions.Count - 1
      questionList(i, 0) = allQuestions(i).getQText
      questionList(i, 1) = allQuestions(i).getQID & " " &
vbTab & allQuestions(i).getQText & " (" & allQuestions(i).getQAnswer &
") [" & allQuestions(i).getQTopic & ", " & allQuestions(i).getQRating
& "]"
    Next
    'Populates the first row of the array with the questions
    from each question in the allquestions collection
    'Populates the second row of the array with the
    corresponding 'list view' of each question
    Dim tempData(1) As String
    'Creates an array with two empty elements
    Dim switchValues As Boolean = True
    'Creates a boolean which will determine whether adjacent
    elements are swapped
    While switchValues = True
      'Loops until all elements of allquestions have been
      compared and the last two do not need to be switched
      switchValues = False
      For i = 0 To allQuestions.Count - 2
        If questionList(i, 0) > questionList(i + 1, 0)
Then
          'The lower question text comes alphabetically
          after the higher one
          switchValues = True
          tempData(0) = questionList(i, 0)
          tempData(1) = questionList(i, 1)
          'Temporarily hold the lower column of the
          array in the temporary array
          questionList(i, 0) = questionList(i + 1, 0)
          questionList(i, 1) = questionList(i + 1, 1)

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        'Move the higher column of the array to the
adjacent lower index
        questionList(i + 1, 0) = tempData(0)
        questionList(i + 1, 1) = tempData(1)
        'Move the data in the temporary array to the
higher index, completing the switch
    End If
    Next
End While
lstQuestions.Items.Clear()
'Clear the question list
For i = 0 To allQuestions.Count - 1
    'For every element in the allquestions collection
    'Add the list display of the alphabetised questions to
the question list
    lstQuestions.Items.Add(questionList(i, 1))
    Next
Else
End If
End Sub

```

```

Private Sub viewClassLogs(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles btnClassLogs.Click, menuLogs.Click
    'Show class logs form
    frmClassLogs.ShowDialog()
End Sub
Private Sub addNewClass(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles menuNewClass.Click
    'Show the class logs form and open the add class form in front
as a dialog
    frmClassLogs.Show()
    frmAddNewClass.ShowDialog()
End Sub
Private Sub addToQuiz(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnAddToQuiz.Click
    'Calls the addToQuiz subroutine when the shortcut is clicked
    Call addToQuiz()
End Sub
Private Sub shortcutAddToQuiz(ByVal sender As System.Object, ByVal
e As System.Windows.Forms.KeyPressEventArgs) Handles
lstQuestions.KeyPress
    If e.KeyChar = Chr(Keys.Return) Then Call addToQuiz()
    'If the user presses return while an element in the question
list is selected, add the element to the quiz
End Sub

```

```

Sub addToQuiz()
    If lstQuestions.SelectedIndex > -1 Then
        'If there is a question selected
        'Get the question index from the list text
        Dim line As String = lstQuestions.SelectedItem.ToString
        Dim questionIndex As Integer = CInt(line.Substring(0,
line.IndexOf(" "))) - 1
        Try
            'Checks if the quiz contains the question before
            adding it to the newquiz collection
            If Not alreadyInQuiz(allQuestions(questionIndex)) Then
                newQuiz.Add(allQuestions.Item(questionIndex))
                lstQuiz.Items.Add(newQuiz.Last.getQText & " (" &
newQuiz.Last.getQAnswer & ")")
                Call countLists()
                'Recounts the question and quiz lists
            Else
                MsgBox("Error. This question is already in the
quiz.")
                'Notifies the user that the question has not been
added
            End If
        Catch
        End Try
    Else : MsgBox("Please select a question and try again.")
    End If
End Sub
Function alreadyInQuiz(ByVal x As Question)
    'Checks if the newquiz collection already contains the
question
    If newQuiz.Contains(x) Then
        alreadyInQuiz = True
    Else
        alreadyInQuiz = False
    End If
End Function
Private Sub deleteFromQuiz(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles btnDeleteFromQuiz.Click
    'Calls the deletefromquiz subroutine when the shortcut is
clicked
    Call deleteFromQuiz()
End Sub
Private Sub shortcutDeleteFromQuiz(ByVal sender As System.Object,
ByVal e As System.Windows.Forms.KeyPressEventArgs) Handles
lstQuiz.KeyPress
    If e.KeyChar = Chr(Keys.Back) Then Call deleteFromQuiz()

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```

'If the user presses backspace while an element in the quiz
list is selected, remove the element from the quiz
End Sub
Sub deleteFromQuiz()
    If lstQuiz.SelectedIndex > -1 Then
        'If there is a question selected
        'Get the question's index in the quiz
        Dim quizIndex As Integer = lstQuiz.SelectedIndex
        Dim result As MsgBoxResult = MsgBox("Are you sure you want
remove this question from the quiz?", MsgBoxStyle.YesNo) 'comfirm
removal
        'Confirm deletion of the question from the quiz
        If result = MsgBoxResult.Yes Then
            newQuiz.RemoveAt(lstQuiz.SelectedIndex)
            lstQuiz.Items.RemoveAt(lstQuiz.SelectedIndex)
            'Remove the question at the selected index from the
quiz list and the newquiz system collection
            Call countLists()
            'Recount the question and quiz lists
            Try
                lstQuiz.SelectedIndex = quizIndex - 1
                'Selects the first element in the quiz
                'Will throw an exception if newQuiz is empty which
will be caught without notification
                Catch
                End Try
            End If
            Else : MsgBox("Please select a question and try again.")
        End If
    End Sub
    Private Sub clearQuiz(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles menuClearQuiz.Click
        If newQuiz.Count > 0 Then
            'If the newquiz collection is not empty, get user
confirmation with the yes/no dialog
            Dim result As MsgBoxResult = MsgBox("Are you sure you want
to clear the current quiz?", MsgBoxStyle.YesNo)
            If result = MsgBoxResult.Yes Then
                'Clear the newquiz collection and the quiz list
                lstQuiz.Items.Clear()
                newQuiz.Clear()
            End If
            Call countLists()
            'Recount the quiz and question lists
        Else : MsgBox("This quiz doesn't contain any questions.")
        End If
    End Sub

```

End Sub

```

    Private Sub exportMoodleQuiz(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles menuExport.Click
        If lstQuiz.Items.Count > 0 Then
            'The algorithm will only run if newquiz is not empty
            exportQuiz.FileName = ""
            'Clear the file name of the export form
            exportQuiz.ShowDialog()
            If exportQuiz.FileName <> "" Then
                Dim type As String
                Dim quizWriter As New
System.IO.StreamWriter(exportQuiz.FileName & ".txt")
                'Create a new instance of the streamwriter class
                For Each item In newQuiz
                    'Iterate through every question in the newquiz
collection
                    type = item.getQType.ToString
                    'Write the string returned by the
exportMoodleQuestion subroutine, passing the question and its type
                    quizWriter.WriteLine(exportMoodleQuestion(item, type))
                Next
                quizWriter.Close()
                'Close the streamwriter
            End If
        Else
            MsgBox("This quiz doesn't contain any questions.")
        End If
    End Sub
    Function exportMoodleQuestion(ByVal q As Question, ByVal type As
String)
        If type = "SA" Then
            'Return the Moodle format for short answer questions
            exportMoodleQuestion = q.getText & " {" & q.getAnswer &
"}" & vbCrLf & vbCrLf
        ElseIf type = "MC" Then
            'Return the Moodle format for multiple choice questions
            exportMoodleQuestion = q.getText & " {" & vbCrLf &
"=" & q.getAnswer & vbCrLf &
"~" & q.getIncorrect(0) & vbCrLf &
"~" & q.getIncorrect(1) & vbCrLf &
"~" & q.getIncorrect(2) & vbCrLf &
"}" & vbCrLf & vbCrLf
        ElseIf type = "TF" Then
    
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        'Return the Moodle format for true/false questions
conditional on what the answer is
        If q.getQAnswer = "True" Then
            exportMoodleQuestion = q.getQText & " {T}" & vbNewLine
& vbNewLine
        Else
            exportMoodleQuestion = q.getQText & " {F}" & vbNewLine
& vbNewLine
        End If
        ElseIf type = "NU" Then
            'Return the Moodle format for numerical questions
            exportMoodleQuestion = q.getQText & " {"#}" & q.getQAnswer &
"}" & vbNewLine & vbNewLine
        Else
            MsgBox("Error. Please try again.")
        End If
    End Function
    Private Sub exportTextQuiz(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles menuSaveQuiz.Click
        If newQuiz.Count > 0 Then
            'The algorithm will only run if newquiz is not empty
            exportQuiz.FileName = ""
            'Clear the file name of the export form
            exportQuiz.ShowDialog()
            exportQuiz.AddExtension = True
            If exportQuiz.FileName <> "" Then
                Dim type As String
                Dim quizWriter As New
System.IO.StreamWriter(exportQuiz.FileName & ".txt")
                Dim msWriter As New
System.IO.StreamWriter(exportQuiz.FileName & " (mark scheme).txt")
                'Create two new instances of the streamwriter class
                'One will export the quiz and the other will export
the mark scheme
                Dim r As New Random
                'Create a new instance of the random integer class
                Dim x As Integer
                For i = 0 To newQuiz.Count - 1
                    'For each element of the quiz, return the type
                    type = newQuiz(i).getQType
                    'Generate a random number between 1 and 4 and
assign it to the variable x
                    x = r.Next(1, 5)
                    'The quizwriter streamwriter writes the string
returned by the exportTextQuestion function
                    'It passes the one based index of the

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        quizWriter.Write(exportTextQuestion(i + 1,
newQuiz(i), type, x))
    'The markscheme streamwriter writes the index of
    the question in the quiz, the correct answer, and the difficulty
    rating
    msWriter.Write(i + 1 & ") " &
newQuiz(i).getQAnswer & vbTab & "[" & newQuiz(i).getQRating & "]"
marks" & vbNewLine & vbNewLine)
    Next
    quizWriter.Close()
    msWriter.Close()
    'Close both streamwriters
End If
Else : MsgBox("This quiz doesn't contain any questions.")
End If
End Sub
Function exportTextQuestion(ByVal i As Integer, ByVal q As
Question, ByVal qtype As String, ByVal x As Integer)
If qtype = "SA" Or qtype = "NU" Or qtype = "TF" Then
    'Exports the index of the question, followed by the
question text and the difficulty rating
    exportTextQuestion = i & ") " & q.getQText & "(" &
q.getQRating & " mark[s])" & vbNewLine & vbNewLine
ElseIf qtype = "MC" Then
    'Uses the random variable passed to determine the order in
which answers are exported
    'Exports the index of the question, followed by the
question text and the difficulty rating and four answers
    If x = 1 Then
        exportTextQuestion = i & ") " & q.getQText & vbTab &
 "(" & q.getQRating & " mark[s])" & vbNewLine &
        "a) " & q.getQAnswer & vbNewLine &
        "b) " & q.getIncorrect(0) & vbNewLine &
        "c) " & q.getIncorrect(1) & vbNewLine &
        "d) " & q.getIncorrect(2) & vbNewLine & vbNewLine
    ElseIf x = 2 Then
        exportTextQuestion = i & ") " & q.getQText & vbTab &
 "(" & q.getQRating & " mark[s])" & vbNewLine &
        "a) " & q.getIncorrect(0) & vbNewLine &
        "b) " & q.getQAnswer & vbNewLine &
        "c) " & q.getIncorrect(1) & vbNewLine &
        "d) " & q.getIncorrect(2) & vbNewLine & vbNewLine
    ElseIf x = 3 Then
        exportTextQuestion = i & ") " & q.getQText & vbTab &
 "(" & q.getQRating & " mark[s])" & vbNewLine &
        "a) " & q.getIncorrect(0) & vbNewLine &

```

```

        "b) " & q.getIncorrect(1) & vbCrLf &
        "c) " & q.getQAnswer & vbCrLf &
        "d) " & q.getIncorrect(2) & vbCrLf & vbCrLf
    Else
        exportTextQuestion = i & ")" & q.getQText & vbTab &
    "(" & q.getQRating & " mark[s])" & vbCrLf &
        "a) " & q.getIncorrect(0) & vbCrLf &
        "b) " & q.getIncorrect(1) & vbCrLf &
        "c) " & q.getIncorrect(2) & vbCrLf &
        "d) " & q.getQAnswer & vbCrLf & vbCrLf
    End If
Else : MsgBox("Error. Please try again.")
End If
End Function

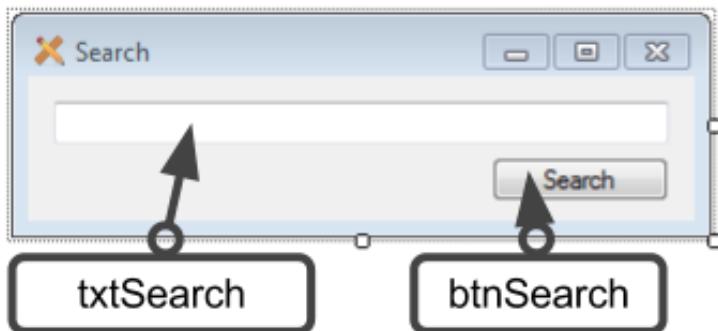
End Class

```

---

### frmTextSearch

Handles the input and validation of text to search questions.



```

Public Class frmTextSearch

    Private Sub startup(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
        'Sets the properties determining whether the user can maximise
        or minimise the form
        Me.MinimizeBox = False
        Me.MaximizeBox = False
    End Sub
    Private Sub searchClicked(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles btnSearch.Click
        'Call the search subroutine
        Call search()
    End Sub

```

```
Private Sub shortcutSearch(ByVal sender As System.Object, ByVal e As System.Windows.Forms.KeyPressEventArgs) Handles txtSearch.KeyPress
    'If the user presses the return key, call the search
    subroutine
        If e.KeyChar = Chr(Keys.Return) Then Call search()
    End Sub
    Sub search()
        Dim searchTerm As String
        If txtSearch.Text = "" Then
            MsgBox("Please enter a search term.")
        Else : searchTerm = txtSearch.Text
            'If the search field is not blank, call the
            searchquestions subroutine on the home form
            frmHome.refreshList()
            frmHome.searchQuestions(searchTerm)
            txtSearch.Clear()
            'Clear the search box
        End If
        txtSearch.Select()
    End Sub
End Class
```

---

## Subroutine and Variable Overview

Every subroutine and variable in the system is listed, under its parent form. Where two subroutines in the same form share a name because the private sub handling a form event calls the public sub to perform a task to eliminate repetition of code, the private sub is prefaced with (Private) to differentiate between them. (Nx) before a subroutine name indicates that there are N almost identical subroutines which handle very similar events and have been grouped together.

### **frmAddEditQuestion**

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event, and the sizing options of the form. Loads the contents of the Units text file into the unit combo box.
cancelChanges	Handles the form closing event, resets the 'editing' Boolean so on the event of the form next opening to add rather than edit a question, all fields are blank.
SASelected	Handles the checking of the short answer question type radio button.
NUSelected	Handles the checking of the numerical question type radio button.
TFSelected	Handles the checking of the true/false question type radio button.
MCSelected	Handles the checking of the multiple choice question type radio buttons.
loadTopics	Gets the selected unit title and passes it to findTopics.
findTopics	Opens the file with the unit name passed to it and loads all topics from the file to the topic combo box.
clearQuestion	Resets the form sizing and fields.
(Private) saveQuestion	Handles the save question button click event, validates all the data entered and if valid, calls saveQuestion (see below.)
saveQuestion	Instantiates a new question, saves the question data and calls either addNewQuestion (see frmHome) passing the question to add it to the allQuestions collection (if editing is set to false) or updateQuestion (see frmHome) passing the question to overwrite it in the allQuestions collection (if editing is set to true.)
saveMultipleChoiceAnswers	Saves validated multiple choice answers for new and existing questions.
editQuestion	Sets the 'editing' Boolean to true to indicate that the question will be overwritten when saved, and loads the form with existing question data.

<b>Subroutine</b>	<b>Description</b>
toggleSize	Handles the character panel click event, and expands or contracts the form depending on the current state of the panel, showing or hiding the special characters.
(Private, 25x) btn_Click	Handles the clicking events of the 25 special characters on the form, calls insertCharacter (see below) and passes the symbol to insert it into the question body.
insertCharacter	Inserts the character passed to it into the body of the question.

<b>Variable</b>	<b>Type</b>	<b>Description</b>
questionType	String	Changes based on the selection of question type from the radio buttons. Used to set the question type when editing/saving.
editing	Boolean	Indicates whether the form is adding a new question or editing an existing one. Events conditional upon this being true are loading the form with data rather than blank, and saving to the selected question index rather than to a new question.
userDirectory	String	The file name of the user profile folder in C://Users, used in saving and loading.
allLines ()	String	Array storing the contents of the units file as it is read.
unit	String	The unit currently selected in the units combo box.
integerTest	Integer	Part of a try-catch mechanism which attempts to convert an integer in a free text field to an integer data type to test its validity. It is assigned the value of the text field.
currentQuestion	Question	Assigned the values of the text fields containing question data whenever a new question is instantiated, and then saved to the allQuestions collection.

### **frmAddLog**

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event, and the sizing options of the form. Loads the log of whichever class is currently selected in frmClassLogs.
cancelChanges	Handles the form closing event, alerts the user of unsaved changes being lost.
handleReturn	Handles the keypress event for the return key, stops the user using return in the text field.
saveLog	Handles the save button click event, validates the log field and if valid, calls addLog (see frmClassLogs.)

<b>Variable</b>	<b>Type</b>	<b>Description</b>
result	MsgBoxResult	The result from the message box which alerts users that if they cancel they will lose unsaved changes, and asks them if they wish to continue.
log	String	Assigned the contents of the text box where users can enter the class log. Changes every time the form is opened and referencing a different class.

### **frmAddNewClass**

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event, and the sizing options of the form.
saveClass	Handles the save button click event, validates the class name field and if valid, sets the log to the default text and adds the new class to the allClasses collection and the list of classes in frmClassLogs.

<b>Variable</b>	<b>Type</b>	<b>Description</b>
newClass	Group	Assigned the value of the new class name and a blank log whenever a new group is instantiated.

### frmClassLogs

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event, and the sizing options of the form. Calls importLogs (see below.)
closeForm	Handles the OK button click event, closes the form.
importLogs	Reads the contents of the logs text file if it exists, and loads data into the allClasses collection of groups. Calls refreshlog (see below.)
backupLogs	Writes the allClasses collection to the logs text file by calling backupLog (see below) for each question. Saves to /UserDirectory/Benchmark
backupLog	Returns the name and log of the class passed to it.
refreshLog	Erases and rewrites the list of classes on the form to update it.
addClass	Handles the add class button click event, loads frmAddClass.
deleteClass	Validates list selection, confirms the deletion of the class and removes the class from allClasses. Calls refreshLog (see above.)
(Private) addLog	Handles the add class button click event. Validates list selection and loads frmAddLog.
addLog	Sets the log of the selected class to the log passed to it by frmAddLog.
logPreview	Handles the index changing on the class list. Loads an unchangeable preview of the log for the selected class.

<b>Variable</b>	<b>Type</b>	<b>Description</b>
allClasses	Collection (of Group)	System collection of every group in the system and their respective logs.
userDirectory	String	The file name of the user profile folder in C://Users, used in saving and loading.
allLines()	String	Array storing the contents of the log backups file as it is read.
savedClass	Group	Assigned the name and log of each class being read back from the backup file before it is added to the allClasses collection.
backup	StreamWriter	StreamWriter used to save class names and logs.
result	MsgBoxResult	The result from the message box which asks users if they are sure they wish to delete a class.
result	MsgBoxResult	The result from the message box which asks users if they are sure they wish to delete a log.

### **frmFilterDifficulty**

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event, and the sizing options of the form. Sets the default filter option.
(5x) Selected	Handles the checking event for each of the five radio buttons. Passes the respective difficulty ratings to filterDifficulty (see frmHome) to filter.
<b>No variables</b>	

### **frmFilterType**

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event, and the sizing options of the form. Sets the default filter option.
(4x) Selected	Handles the checking event for each of the four radio buttons. Passes the respective question types to filterType (see frmHome) to filter.
<b>No variables</b>	

### **frmFilterUnitTopic**

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event, and the sizing options of the form. Loads all units as parent nodes and all topics as child nodes of their respective parents from the unit and topic text files. Collapses all nodes.
nodeChanged	Handles the after select event for the tree, and passes the level and title of the selected index to filterUnitTopic (see frmHome.)

<b>Variable</b>	<b>Type</b>	<b>Description</b>
userDirectory	String	The file name of the user profile folder in C://Users, used in saving and loading.
allLines ()	String	Array storing the contents of the units file as it is read.
parentNode	TreeNode	Each unit is temporarily declared as a parentNode while being read from the file and having topic nodes added as children.
topicLines ()	String	Array storing the contents of the topics files as they are read.
nodeTitle	String	The title of the node selected.

**frmHome**

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event. Calls setToolTips, importAllQuestions and countLists (see below.) Creates the default unit and topic text files if none exist already.
setToolTips	Sets the tool tips for the icons on the form.
countLists	Counts the elements in allQuestions and newQuiz and displays them in the toolbar at the bottom of the form.
importAllQuestions	Reads the contents of the questions text file if it exists, and loads data into the allQuestions collection of questions. Calls refreshList (see below.)
backupAllQuestions	Overwrites the questions text file by iteratively calling backupQuestion (see below) and writing the returned value to the file.
backupQuestion	Returns all the question data associated with the question passed to it.
refreshList	Handles the refresh button click event and the view all menu click event. Erases and rewrites the question list from allQuestions, recounts them, and calls backupAllQuestions. Calls countLists.
refreshQuiz	Erases and rewrites the quiz list from newQuiz. Calls countLists.
(Private) addNewQuestion	Handles the new question button click event and the new question menu click event. Calls clearQuestion (see frmAddEditQuestion) and loads frmAddEditQuestion.
addNewQuestion	Adds the question passed to it to the allQuestions collection and updates the question list to include it. Calls countLists.
editQuestion	Validates list selection and if valid, loads frmAddEditQuestion, passing it the index of the currently selected question in allQuestions.
updateQuestion	Overwrites the question at the selected index of the question list with the data from the question passed to it by saveQuestion (see frmAddEditQuestion.) Updates the question list, then calls refreshList and refreshQuiz.

<b>Subroutine</b>	<b>Description</b>
deleteQuestion	Handles the delete button click event and the delete menu click event. Validates the list selection, and confirms the deletion of the selected question before deleting it from allQuestions and the question list. Attempts to delete the question from the quiz (if it exists there) and notifies the user if this is successful. Calls refreshList.
(Private) searchQuestions	Handles the search button click event and the search menu click event. Loads frmTextSearch.
searchQuestions	Clears the question list and iterates through allQuestions searching for the term passed to it by frmTextSearch, adding any questions which contain the term to the list and displaying it in its filtered form. If no results are found, it notifies the user. Calls countLists.
(Private) filterUnitTopic	Handles the filter by unit/topic menu click event. Loads frmFilterUnitTopic.
filterUnitTopic	Clears the list and depending on whether the node level passed to it by frmFilterUnitTopic is 1 or 2, iterates through all questions and either adds questions to the list where the unit matches the title (passed 1) or where the topic matches the title (passed 2) to display the question list in its filtered form. Calls countLists.
(Private) filterDifficulty	Handles the filter by difficulty menu click event. Loads frmFilterDifficulty.
filterDifficulty	Clears the question list and iterates through allQuestions, adding questions which have the same difficulty as was passed by frmFilterDifficulty. Calls countLists.
(Private) filterType	Handles the filter by type menu click event. Loads frmFilterType.
filterType	Clears the question list and iterates through allQuestions, adding questions which have the same type as was passed by frmFilterType. Calls countLists.
(Private) alphabetSort	Handles the sort alphabetically menu click event. Populates an array with question data and bubblesorts the question text, adding each item of the sorted alphabetical array to the question list.
viewClassLogs	Handles the class logs button click event and the class logs menu click event. Loads frmClassLogs.

<b>Subroutine</b>	<b>Description</b>
addNewClass	Handles the add new class menu click event. Loads frmAddNewClass.
(Private) addToQuiz	Handles the add to quiz button click event. Calls addToQuiz (see below.)
shortcutAddToQuiz	Handles the keypress event in the question list. If the keypress is the return key, it calls addToQuiz (see below.)
addToQuiz	Validates the list selection, and if valid, checks if the question is already in the quiz by calling alreadyInQuiz (see below.) If the question is in the quiz then the user is notified, if it's not then the selected question is added to the newQuiz collection and the quiz list. Calls countLists.
alreadyInQuiz	Checks for the presence of the question in allQuestions at the index passed to it in newQuiz. If it exists in newQuiz, returns true and otherwise returns false.
(Private) deleteFromQuiz	Handles the delete from quiz button click event. Calls deletefromQuiz (see below.)
shortcutDeleteFromQuiz	Handles the keypress event in the quiz list. If the keypress is the backspace key, it calls deleteFromQuiz (see below.)
deleteFromQuiz	Validates the list selection, and if valid, confirms the deletion of the question from the quiz. Removes the question from the quiz list and from newQuiz.
clearQuiz	Handles the clear quiz menu click event. Validates list selection, and confirms the clearing with the user. Clears both newQuiz and the quiz list. Calls countLists.
exportMoodleQuiz	Validates the presence of questions in newQuiz. Prompts the user for a file name and path, then calls exportMoodleQuestion for each question in newQuiz (passing the question and the question type), writing the returned values to a text file.
exportMoodleQuestion	Depending on the question type passed to it, the function gets question data from the question passed to it and formats it using .gift file formatting.

<b>Subroutine</b>	<b>Description</b>
exportTextQuiz	Validates the presence of questions in newQuiz. Prompts the user for a file name and path, then calls exportTextQuestion for each question in newQuiz (passing the index of the question in newQuiz, the question, the question type, and a random number between one and four), writing the returned values to a text file. For each question iterated through, it writes the same index, and the difficulty rating and answer to a mark scheme text file.
exportTextQuestion	Depending on the question type passed to it, the function either returns the question text and difficulty rating (short answer, numerical or true/false) or uses the random number passed to ‘shuffle’ the answers, preventing the consistent ordering of the correct answer within the incorrect ones.

<b>Variable</b>	<b>Type</b>	<b>Description</b>
allQuestions	Collection (of Question)	System collection of every question in the system and all associated question data.
newQuiz	Collection (of Question)	System collection of every question in the current quiz and all associated data.
defaultUnitTopicSetup	StreamWriter	StreamWriter used to save unit/topic defaults if there are no unit/topic files.
userDirectory	String	The file name of the user profile folder in C://Users, used in saving and loading.
allLines ()	String	Array storing the contents of the question backups file as it is read.
count	Integer	Stepper variable, increments every time a new question is read from the backup file.
savedQuestion	Question	Assigned all of the question data of each question being read back from the backup file before it is added to the allQuestions collection.
backup	StreamWriter	StreamWriter used to save question data.
line	String	The currently selected list item.
idIndex	Integer	The integer found directly before “ ” in line (see above), which is the selected question’s ID.
questionIndex	Integer	The index of the selected element in the question list.

<b>Variable</b>	<b>Type</b>	<b>Description</b>
qDelete	Question	A question being deleted from the question bank.
result	MsgBoxResult	The result from the message box which asks users if they are sure they wish to delete a question.
found	Boolean	Conditional on whether a specified string has been found within a question being searched.
questionList(x,1)	(2D Array) String	(Where x = allQuestions.count) Temporarily stores question text and all other question data from every question in allQuestions while it is alphabetically sorted.
tempData(1)	(1D Array) string	Holds the data being swapped in the sorting process.
switchValues	Boolean	Conditional on whether one array element holds a greater value than its subsequent element, determines whether the 'swap' takes place.
quizIndex	Integer	The index of the selected element in the quiz.
result	MsgBoxResult	The result from the message box which asks users if they are sure they wish to remove a question from the quiz.
result	MsgBoxResult	The result from the message box which asks users if they are sure they wish to clear the quiz.
type	String	Question type of the question currently being exported.
quizWriter	StreamWriter	StreamWriter used to export quizzes.
msWriter	StreamWriter	StreamWriter used to export mark schemes.
r	Random	Used to generate a series of random numbers for ordering multiple choice answers.
x	Integer	The random number values generated by r (see above.)

**frmTextSearch**

<b>Subroutine</b>	<b>Description</b>
startup	Handles the form loading event, and the sizing options of the form.
searchClicked	Handles the search button click event.
shortcutSearch	Handles the keypress event. If the keypress is the return key, it calls search (see below.)
Search	Validates the presence of a search term.

<b>Variable</b>	<b>Type</b>	<b>Description</b>
searchTerm	String	The string entered by the user which will be searched for.

## Detailed Algorithm Design

<b>Algorithm:</b> Question Backup	<b>Location:</b> frmHome, backupAllQuestions()
<b>Description</b>	
The algorithm gets the file path of the user directory and writes/overwrites a question file, calling the backupQuestion function for each question in the question bank. backupQuestion returns question data over nine consecutive lines.	
<b>Pseudo-code</b>	
<pre> Var backup ← File(user\Benchmark\Questions.txt) FOR i ← 0 TO allQuestions.count - 1     WRITELINE(backup, backupQuestion(Questions(i))) NEXT  FUNCTION backupQuestion(question)     backupQuestion = question.text &amp; newline &amp; question.type &amp;     newline &amp; question.answer &amp; newline &amp; question.incorrect[0]     &amp; newline &amp; question.incorrect[1] &amp; newline &amp;     question.incorrect[2] &amp; newline &amp; question.unit &amp; newline &amp;     question.topic &amp; newline &amp; question.rating END FUNCTION </pre>	
<b>Code</b>	
<pre> Dim backup As New System.IO.StreamWriter(userDirectory &amp; "\Benchmark\Questions.txt") For i = 0 To allQuestions.Count - 1     backup.WriteLine(backupQuestion(allQuestions(i))) Next backup.Close()  Function backupQuestion(ByVal q As Question)     backupQuestion = q.getQText &amp; vbNewLine &amp; q.getQType &amp; vbNewLine &amp;     q.getQAnswer &amp; vbNewLine &amp; q.getIncorrect(0) &amp; vbNewLine &amp;     q.getIncorrect(1) &amp; vbNewLine &amp; q.getIncorrect(2) &amp; vbNewLine &amp;     q.getQUnit &amp; vbNewLine &amp; q.getQTopic &amp; vbNewLine &amp; q.getQRating &amp;     vbNewLine End Function </pre>	

<b>Algorithm:</b> Deleting a question	<b>Location:</b> frmHome, deleteQuestion()
<b>Description</b>	
The algorithm gets the question ID of the selected list item, and after checking it is valid (i.e. That there is an item selected) it asks the user to confirm deletion. It then checks if the question is in the quiz, and removes it if it is. Finally, it removes it from the allQuestions collection and updates the quiz and question lists.	
<b>Pseudo-code</b>	
Var idIndex ← STR(quiz.item.index)	

```

IF idIndex > 0 THEN
    OUTPUT("Are you sure you want to delete this question")
    IF answer = Yes THEN
        Var qDelete ← allQuestions(idIndex)
        IF alreadyInQuiz(qDelete) THEN
            Var quizIndex ← newQuiz(qDelete.index)
            quiz.remove(quizIndex)
            OUTPUT("Question has been removed.")
        ENDIF
        newQuiz.remove(qDelete)
        quiz.items.remove(idIndex)
        allQuestions.remove(qDelete)
        Refreshlist()
    ENDIF
    ELSE OUTPUT("Error. No question selected.")
ENDIF

```

**Code**

```

Dim qDelete As Question
Dim line As String = lstQuestions.SelectedItem.ToString
Dim idIndex As Integer = CInt(line.Substring(0, line.IndexOf(" "))) - 1
Dim quizIndex As Integer
If idIndex > -1 Then
    Dim result As MsgBoxResult = MsgBox("Are you sure you want delete
this question?", MsgBoxStyle.YesNo)
    If result = MsgBoxResult.Yes Then
        qDelete = allQuestions.Item(idIndex)
        If alreadyInQuiz(qDelete) Then
            quizIndex = newQuiz.IndexOf(qDelete)
            lstQuiz.Items.RemoveAt(quizIndex)
            MsgBox("Question has also been removed from current quiz.")
        End If
        newQuiz.Remove(qDelete)
        lstQuestions.Items.RemoveAt(idIndex)
        allQuestions.Remove(qDelete)
        Call refreshList()
    End If
    Else : MsgBox("Error. No question selected.")
End If

```

<b>Algorithm:</b> Filtering by unit/topic	<b>Location:</b> frmFilterUnitTopic & frmHome, filterUnitTopic()
<b>Description</b>	
<p>This algorithm is run every time the user selects a node in the unit/topic tree. The index of the selection (units have index = 0, topics have index = 1) and the title of the node is passed to filterUnitTopic, where it is checked against all questions in the collection and any matches are added to the question list.</p>	
<b>Pseudo-code</b> <pre> Var treeIndex ← tree.node.level + 1 Var nodeTitle ← tree.node.text filterUnitTopic(treeIndex, nodeTitle)  PROCEDURE filterUnitTopic(treeIndex, nodeTitle)     IF treeIndex = 1 THEN         FOR i ← 0 TO LEN(allQuestions) - 1             list.items.clear             IF allQuestions(i).unit = nodeTitle THEN                 list.items.add(allQuestions(i).qID &amp; " " &amp;                 newline &amp; allQuestions(i).text &amp; " (" &amp;                 allQuestions(i).answer &amp; " ) [") &amp;                 allQuestions(i).topic &amp; ", " &amp;                 allQuestions(i).rating &amp; "]")             ENDIF         NEXT         countLists()     ELSEIF treeIndex = 2         list.items.clear         FOR i ← 0 TO LEN(allQuestions) - 1             IF allQuestions(i).topic = nodeTitle THEN                 list.items.add(allQuestions(i).qID &amp; " " &amp;                 newline &amp; allQuestions(i).text &amp; " (" &amp;                 allQuestions(i).answer &amp; " ) [") &amp;                 allQuestions(i).topic &amp; ", " &amp;                 allQuestions(i).rating &amp; "]")             ENDIF         NEXT         countLists()     END IF END PROCEDURE </pre>	

**Code**

```

Dim treeIndex As Integer = unitTopicTree.SelectedNode.Level + 1
Dim nodeTitle As String = unitTopicTree.SelectedNode.Text
frmHome.filterUnitTopic(treeIndex, nodeTitle)

Sub filterUnitTopic(ByVal treeIndex, ByVal nodeTitle)
    If treeIndex = 1 Then
        lstQuestions.Items.Clear()
        For i = 0 To allQuestions.Count - 1
            If allQuestions.ElementAt(i).getQUnit = nodeTitle Then
                lstQuestions.Items.Add(allQuestions(i).getQID & " " & vbTab
                & allQuestions(i).getQText & " (" &
                allQuestions(i).getQAnswer & ")" [ " &
                allQuestions(i).getQTopic & ", " &
                allQuestions(i).getQRating & "]")
            End If
        Next
        Call countLists()
    ElseIf treeIndex = 2 Then
        lstQuestions.Items.Clear()
        For i = 0 To allQuestions.Count - 1
            If allQuestions.ElementAt(i).getQTopic = nodeTitle Then
                lstQuestions.Items.Add(allQuestions(i).getQID & " " & vbTab
                & allQuestions(i).getQText & " (" &
                allQuestions(i).getQAnswer & ")" [ " &
                allQuestions(i).getQTopic & ", " &
                allQuestions(i).getQRating & "]")
            End If
        Next
        Call countLists()
    End If
End Sub

```

<b>Algorithm:</b> Shortcut for adding questions to the quiz	<b>Location:</b> frmHome, shortcutAddToQuiz()
<b>Description</b>	
If the question list has focus and there is a question selected, hitting the return key will call the addToQuiz function. This algorithm recognises the input. (Almost identical to the shortcutDeleteFromQuiz function)	
<b>Pseudo-code</b>	
<pre>Var e ← keyPressEventArgument IF INT(e.value) = 13 THEN     AddToQuiz() ENDIF</pre>	
<b>Code</b>	
<pre>Private Sub shortcutAddToQuiz(ByVal sender As System.Object, ByVal e As System.Windows.Forms.KeyPressEventArgs) Handles lstQuestions.KeyPress      If e.KeyChar = Chr(Keys.Return) Then Call addToQuiz() End Sub</pre>	

<b>Algorithm:</b> Alphabetically sorting questions	<b>Location:</b> frmHome, alphabetSort()
<b>Description</b>	
This algorithm fills a 2-dimensional array with data from allQuestions temporarily to sort them. In the first column is the string being sorted, the question text of each question. In the second is the corresponding other question data in the format in which it would be added to the question list. The array elements are then bubblesorted, comparing each element in the array with the adjacent one below. If (i+1) is larger than (i), the two elements and their corresponding data switch positions in the array.	
<b>Pseudo-code</b>	
<pre>Var questionList ← [LEN(allQuestions) - 1, 1] FOR i ← 0 to LEN(allQuestions) - 1     questionList[i, 0] = allQuestions(i).text     questionList[i, 1] = allQuestions(i).qID &amp; " " &amp; newline &amp;         allQuestions(i).text &amp; "(" &amp; allQuestions(i).answer &amp; ")"         [") &amp; allQuestions(i).topic &amp; ", " &amp; allQuestions(i).rating         &amp; "]" NEXT Var tempData[1] Var switchValues ← True WHILE switchValues = True     switchValues = False     FOR i ← 1 to LEN(allQuestions) - 2         IF questionList[i, 0] &gt; questionList [i+1, 0] THEN</pre>	

```

switchValues = True
tempData[0] = questionList[i, 0]
tempData[1] = questionList[i, 1]
questionList[i, 0] = questionList[i+1, 0]
questionList[i, 1] = questionList[i+1, 1]
questionList[i+1, 0] = tempData[0]
questionList[i+1, 1] = tempData[1]
ENDIF
NEXT
END WHILE

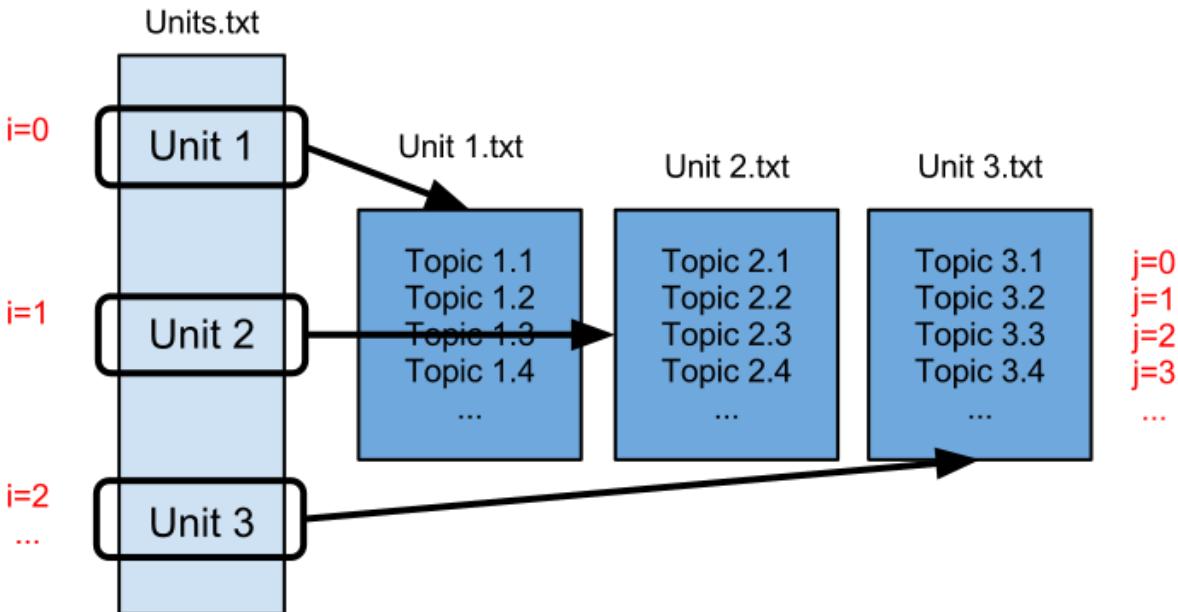
```

**Code**

```

Dim questionList(allQuestions.Count - 1, 1) As String
For i = 0 To allQuestions.Count - 1
    questionList(i, 0) = allQuestions(i).getQText
    questionList(i, 1) = allQuestions(i).getQID & " " & vbTab &
        allQuestions(i).getQText & "(" & allQuestions(i).getQAnswer & ")" &
        allQuestions(i).getQTopic & "," & allQuestions(i).getQRating & "]"
Next
Dim tempData(1) As String
Dim switchValues As Boolean = True
While switchValues = True
    switchValues = False
    For i = 0 To allQuestions.Count - 2
        If questionList(i, 0) > questionList(i + 1, 0) Then
            switchValues = True
            tempData(0) = questionList(i, 0)
            tempData(1) = questionList(i, 1)
            questionList(i, 0) = questionList(i + 1, 0)
            questionList(i, 1) = questionList(i + 1, 1)
            questionList(i + 1, 0) = tempData(0)
            questionList(i + 1, 1) = tempData(1)
        End If
    Next
End While

```

<b>Algorithm:</b> Loading units and topics into the tree from which questions are filtered	<b>Location:</b> frmFilterUnitTopic, startup()
<b>Description</b>	
The tree is first cleared of all nodes, and then the units text file is opened. For every unit (line in the file) read, it is first added to the tree as a parent node, and then the text file associated with that unit is opened and all topics (lines in the topic file) are added as child nodes. Finally, all nodes are collapsed.	
<b>Illustrative Diagram</b>	
 <p>The diagram illustrates the loading of units and topics into a tree. It shows three units (Unit 1, Unit 2, Unit 3) with their respective topic files (Unit 1.txt, Unit 2.txt, Unit 3.txt). The units are indexed <math>i=0</math>, <math>i=1</math>, <math>i=2</math>. The topics are indexed <math>j=0</math>, <math>j=1</math>, <math>j=2</math>, <math>j=3</math>. Arrows show the relationship between units and their topics.</p>	<pre> +----- Unit 1   unitTopicTree.Nodes.Add(parentNode)       +----- Topic 1.1  parentNode.Nodes.Add(node)       +----- Topic 1.2  parentNode.Nodes.Add(node)       +----- Topic 1.3  parentNode.Nodes.Add(node)       +----- Topic 1.4  parentNode.Nodes.Add(node)  +----- Unit 2   unitTopicTree.Nodes.Add(parentNode)       +----- Topic 2.1  parentNode.Nodes.Add(node)       +----- Topic 2.2  parentNode.Nodes.Add(node)       +----- Topic 2.3  parentNode.Nodes.Add(node)       +----- Topic 2.4  parentNode.Nodes.Add(node)   </pre>

**Code**

```
unitTopicTree.Nodes.Clear()
Dim userDirectory As String =
Environment.GetEnvironmentVariable("userprofile")
If System.IO.File.Exists(userDirectory & "\Benchmark\Units.txt") Then
    Dim allLines() As String = System.IO.File.ReadAllLines(userDirectory &
"\Benchmark\Units.txt")
    If allLines.Length > 0 Then
        For i = 0 To allLines.Length - 1
            Dim parentNode As TreeNode =
unitTopicTree.Nodes.Add(allLines(i))
            Dim topicLines() As String =
System.IO.File.ReadAllLines(userDirectory & "\Benchmark\" &
allLines(i) & ".txt")
            If topicLines.Length > 0 Then
                For j = 0 To topicLines.Length - 1
                    parentNode.Nodes.Add(topicLines(j))
                Next
            End If
        Next
        unitTopicTree.Update()
    End If
Else : unitTopicTree.Nodes.Add("Unknown unit")
End If
unitTopicTree.CollapseAll()
```

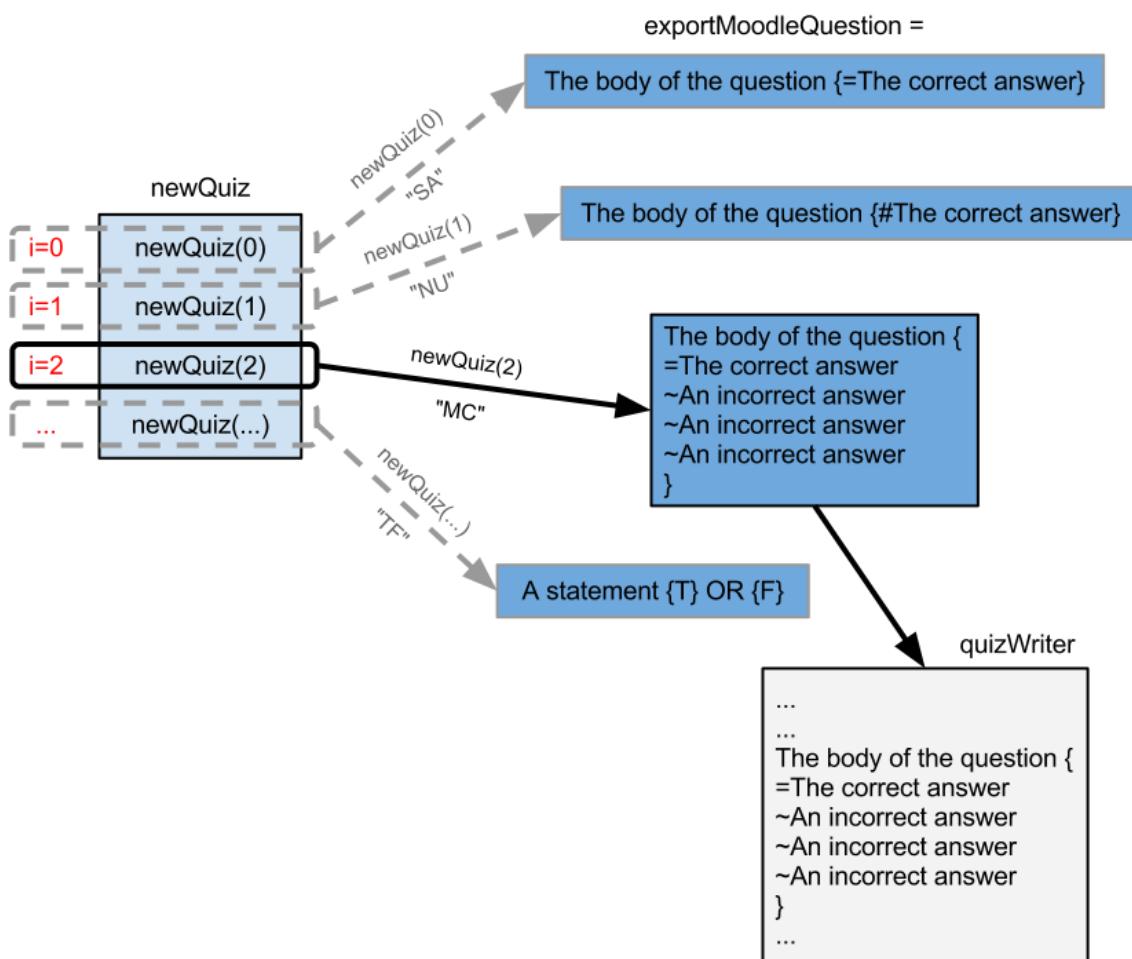
**Algorithm:** Exporting quizzes in the Moodle GIFT format

**Location:** frmHome, exportMoodleQuiz()

### Description

If the quiz contains more than zero questions, a save dialog is opened and the user is prompted to select a file location and name the export file. A StreamWriter is opened and for each item in the quiz, the exportMoodleQuestion function is called to return the relevant data in the GIFT format in order for it to be written to the text file. After all questions have been written, the StreamWriter is closed.

### Illustrative Diagram



### Code

```

If lstQuiz.Items.Count > 0 Then 'there are questions in the quiz
    exportQuiz.FileName = ""
    exportQuiz.ShowDialog()
    If exportQuiz.FileName <> "" Then
        exportQuiz.FileName = exportQuiz.FileName & ".txt"
        Dim type As String
        Dim quizWriter As New

```

```

System.IO.StreamWriter(exportQuiz.FileName)
For Each item In newQuiz
    type = item.getQType.ToString
    quizWriter.WriteLine(exportMoodleQuestion(item, type))
Next
quizWriter.Close()
End If
Else
    MsgBox("This quiz doesn't contain any questions.")
End If

Function exportMoodleQuestion(ByVal q As Question, ByVal type As String)
    If type = "SA" Then
        exportMoodleQuestion = q.getText & " {" & q.getQAnswer &
            "}" & vbCrLf & vbCrLf
    ElseIf type = "MC" Then
        exportMoodleQuestion = q.getText & " {" & vbCrLf &
            "=" & q.getQAnswer & vbCrLf &
            "~" & q.getIncorrect(0) & vbCrLf &
            "~" & q.getIncorrect(1) & vbCrLf &
            "~" & q.getIncorrect(2) & vbCrLf &
            "}" & vbCrLf & vbCrLf
    ElseIf type = "TF" Then
        If q.getQAnswer = "True" Then
            exportMoodleQuestion = q.getText & " {T}" & vbCrLf
            & vbCrLf
        Else
            exportMoodleQuestion = q.getText & " {F}" & vbCrLf
            & vbCrLf
        End If
    ElseIf type = "NU" Then
        exportMoodleQuestion = q.getText & " {" & q.getQAnswer &
            "}" & vbCrLf & vbCrLf
    ----
    MsgBox("Error. Please try again.")
End If
End Function

```

## Post-Implementation System Overview

### IOPS Chart

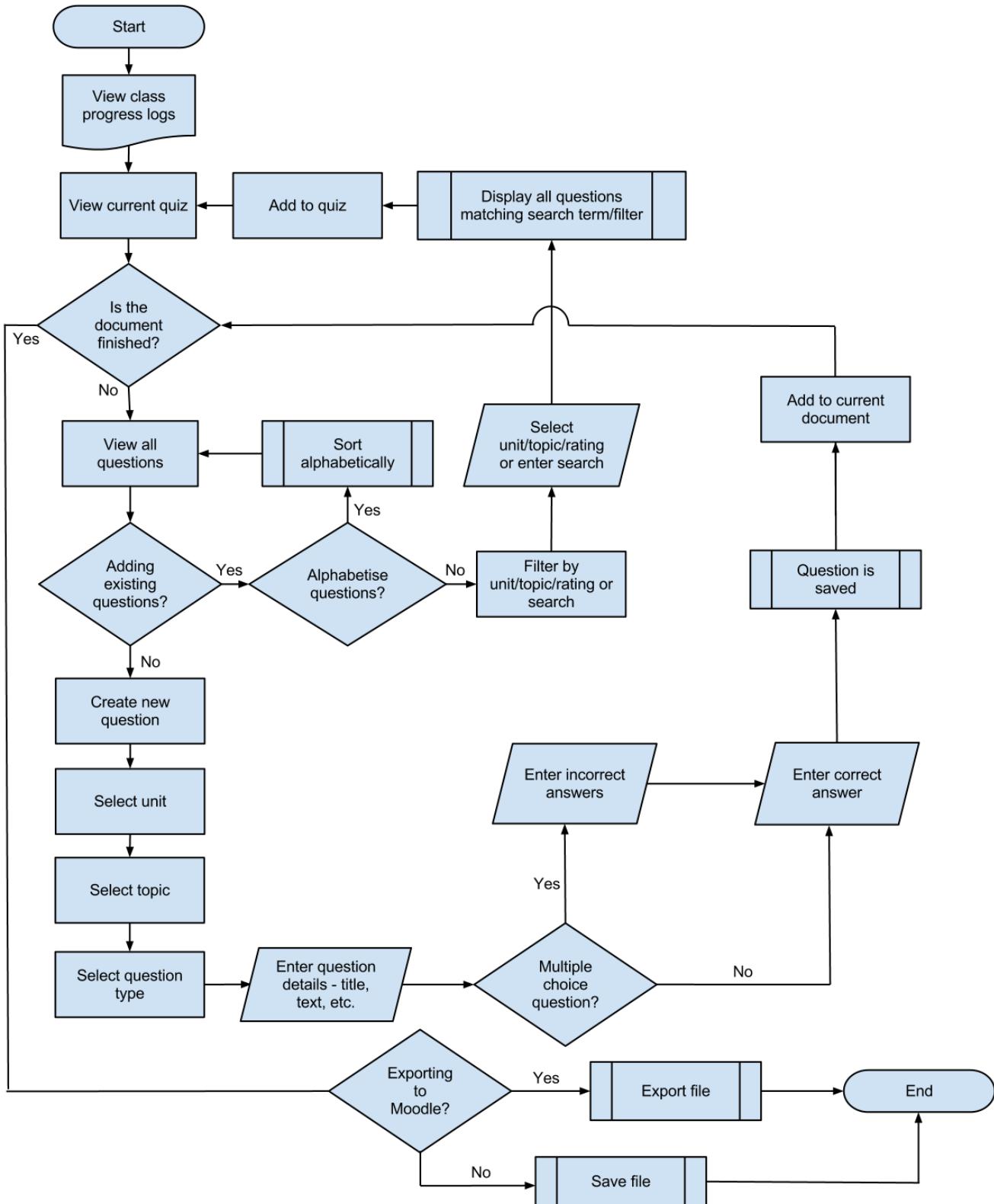
The following chart outlines the input, output, process and storage components of the new system in the most concise way. This can be cross-referenced with the original IOPS design on page 32.

Data flow remains the same as in design, which can be seen on page 34.

<i>Input</i>	<i>Process</i>
<ul style="list-style-type: none"> <li>● Class record (recent topic)</li> <li>● Class name</li> <li>● Unit of work</li> <li>● Topic</li> <li>● Question type</li> <li>● Question text</li> <li>● Correct answer</li> <li>● Incorrect answers (if multiple choice)</li> <li>● File name (when saving)</li> </ul>	<ul style="list-style-type: none"> <li>● Retrieve and display questions from text file</li> <li>● Save questions to text file</li> <li>● Save question documents</li> <li>● Convert questions to Moodle .gift format</li> <li>● Sort questions alphabetically</li> <li>● Search for strings within questions</li> <li>● Filter questions by unit, topic etc.</li> </ul>
<i>Storage</i>	<i>Output</i>
<ul style="list-style-type: none"> <li>● Question text-file</li> <li>● Class log text-file</li> <li>● Units text file</li> <li>● Individual topic text files</li> </ul>	<ul style="list-style-type: none"> <li>● Moodle GIFT file</li> <li>● Digital question document</li> </ul>

### System Flowchart

On the following page is an update of the system flowchart from design, which can be seen on page 32. Processes such as searching and filtering have been included in more depth, and features added at the end of design such as alphabetising questions have been included.



# User Guide

---



## Installation Guidelines

## Installation from a USB Flash-Drive





## Using the System

### Creating Questions



## Deleting Questions

## Adding and Removing Questions from the Quiz

## Adding and Deleting Classes

## Adding and Deleting Class Logs

## Searching Questions

## Filtering Questions by Unit, Topic or Difficulty



## Exporting Quizzes

## Uploading Quizzes to Moodle



## Troubleshooting



# Appraisal

---

## Comparison of Project Performance Against Objectives

The following table compares the performance of the completed system to the objectives originally laid out on page 28, to assess whether all the user's needs have been met.

Key:

Objective not met	Objective partially met	Objective met	Objective exceeded
-------------------	-------------------------	---------------	--------------------

Original Objective	Completed System
Question, answer, unit, topics and type should be mandatory for each [question entered].	Each question in the system stores question text, a correct answer, a unit, a topic, and a question type. The idea of entering general more specific topics was remodelled during implementation to allow for more time-saving question entry.
For multiple choice questions, the incorrect answers should also be stored.	Multiple choice questions store three incorrect answers. However, other question types still have incorrect answer properties which are simply not used.
There should be a default difficulty rating for each question (out of five) which can be edited or left as the default.	The default rating which the form loads with is 1 (out of five.) Other ratings can be selected from the drop-down combo box.
There should be different question types available similar to the types that feature in the exams – short answer, calculation, etc.	Questions can be one of four types; short answer, multiple choice, true/false, or numerical answer.
The questions must be searchable and displayable by question type, unit, topic, and difficulty rating.	The user can search for questions by selecting a question type, unit, topic or difficulty rating. Questions can also be alphabetised.
Users must be able to search all questions for a specific string.	Users can search all questions for a specific string and all questions containing that string are returned.
Searching questions should involve the minimum free text entry to save time and minimise errors. This could be implemented using radio buttons or drop-down menus for selection.	To search by question type or difficulty rating, the user selects their choice using radio buttons. To choose a unit or topic, they choose a node on a tree.

Original Objective	Completed System
The user must be able to edit existing questions or delete them from the database.	Every detail of a question can be edited, and questions can be deleted. If a question is deleted from the system, it is also deleted from the quiz if present there too.
The user should be able to preview the answer to each question that is displayed.	The (correct) answer to each question is displayed in brackets after each question in the question list, but there is no way to hide it.
The user must be able to add records of new classes to the system.	New classes can be added to the system and logs can be added to those classes.
Each class stored must have its own 'log' which would allow free text entry similar to a teacher's diary. The user must be able to record recently set questions from the textbook or chapters covered and retrieve this information when assigning new questions.	Users have free text entry (excluding use of the return key) of up to 500 characters to store information on the current progress of each class. These can be accessed at any time.
The user must be able to delete classes or class logs from the system.	Both logs and classes can be deleted from the system.
The user should be able to create a quiz by selecting questions from the database and/or adding new questions.	The user can add new questions or select existing questions and add them to a quiz.
The system must notify the user if they are adding a question to a quiz which already contains it to prevent unnecessary duplicates.	The system notifies the user with a dialog box if they are adding a duplicate question to the quiz.
The user should be able to export text-based quizzes as text files to be emailed or printed.	The system can export text-based quizzes, but cannot email or print them from within the system.
Text-based quizzes should have separate numbered mark schemes unlike the integrated Moodle quizzes.	Text based quizzes are saved with a numbered mark scheme of the same name suffixed by (Mark scheme) in the same directory, which also contains the marks each question carries.
The system should be able to export quizzes with integrated answers in a format and the UTF-8 encoding recognised by Moodle.	The system exports GIFT files which can be uploaded directly to Moodle.
Users should be able to see at all times a 'count' of how many questions they are viewing and how many are in the current quiz.	The status strip at the bottom of the home screen shows a live count of how many questions are in the system, and how many are in the current quiz.
The system must include button shortcuts for common actions such as adding and removing questions to or from quizzes in order to reduce the time spent navigating menus.	The system contains shortcuts for refreshing any searches, adding and deleting questions, editing questions, viewing the class logs form, searching questions, and adding/removing questions to/from quizzes.

## Potential for Future Developments

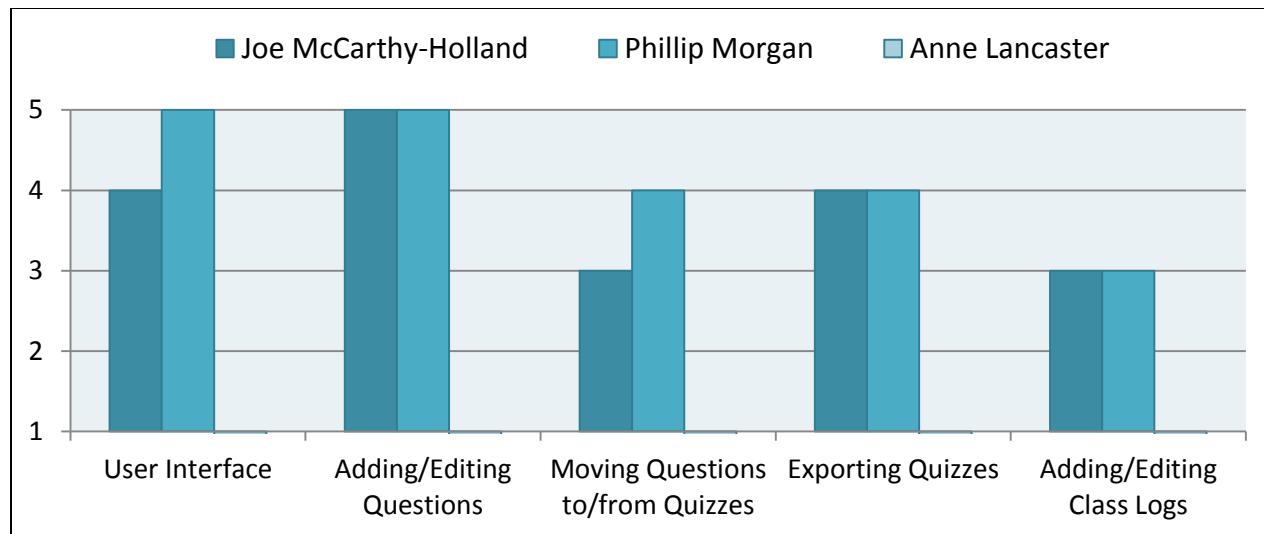
As a default, the units and topics read into the system are those from the AQA Physics A specification (AS - 2009 onwards; A2 - 2010 onwards.) As the specification is subject to change, it follows that the unit and topic data read by the system will change as well. At present, new units and topics can be added by adding the unit to C:\\Users\\UserProfile\\Benchmark\\Units.txt on its own line, and creating a UTF-8 encoded text file with the same name as the unit, containing a list of its topics on separate lines. This can all be done in a simple text editor such as Notepad. However, if existing units or topics are deleted, questions from those topics will not be searchable or editable. A potential development would include a separate category for old-specification units or topics, so they are still searchable but can be hidden when not required.

Another development which could be implemented is the inclusion of images or diagrams in questions, which Moodle can process. This feature would be more complex than any of the question features currently in the system and I'm limited by my time-frame and own ability, and as such unable to include it. For someone maintaining the system with more time available however, this would be possible, and allow an even wider range of questions to be added as diagrams are fairly common in A-Level physics exams.

If teachers wished to import questions from old Moodle quizzes directly into the system, this feature could also be implemented with use of existing classes, subroutines and functions. However, in the original interview this was never considered a desirable feature so at the time of design, it wasn't necessary to add to the system.

## Analysis of User Feedback

I gave the installation files, user guide and a feedback questionnaire to each of the three teachers in the physics department. In order to get an objective assessment of how the users rated the system after the initial use, I asked them to rate the interface, adding/removing questions process, moving questions process, exporting process, and class logs system out of five (five being the highest.) I then asked for additional feedback on any aspect of the system, and have summarised their thoughts below.



Desirable features/changes		
Joe	Phillip	Anne
<ul style="list-style-type: none"> <li>Multiple question selection</li> <li>Not allowing multiple classes with the same name</li> <li>Labeled icons rather than tooltips</li> <li>Cumulative filtering rather than resetting the filter each time the user searches</li> </ul>	<ul style="list-style-type: none"> <li>More of an explanation of quizzes in the user manual</li> <li>Linking class lists with Moodle class lists on Godalming Online</li> </ul>	

Changes such as switching tooltips for labels, class validation to ensure groups aren't added twice, and cumulative filtering can be implemented as part of the next release of Benchmark. These would be the objectives for the second pass through the systems development life cycle.

# Bench mark

## User Feedback Form

Please rate the following aspects of the system out of five:

User interface

Adding and editing questions

Moving questions to and from the quiz

Exporting and saving quizzes

Adding and editing class logs

5: Unusable	4: Poor	3: Neutral	2: Good	1: Excellent
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Additional feedback on features such as clarity of user guide, ease of use of the system, etc.

It would have been nice to multi select Questions when moving to quiz.  
Doesn't validate against multiple class names  
All of the buttons are a mystery until roll over.  
Filtering isn't cumulative → only one filter at a time

Signed: J. Tally-Brown

Date: 26/2/13

# Bench mark

## User Feedback Form

Please rate the following aspects of the system out of five:

User interface

5: Unusable	4: Poor	3: Neutral	2: Good	1: Excellent
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Adding and editing questions

Moving questions to and from the quiz

Exporting and saving quizzes

Adding and editing class logs

Additional feedback on features such as clarity of user guide, ease of use of the system, etc.

A thorough, effective and nice looking system. I had some trouble with the installation, but suspect that was to do with network rights. Anyway, I was able to run from USB. The adding and editing of questions was very straight-forward and the learning facilities were excellent. I found the creation of quizzes a little more cryptic – it was easy to do, but perhaps would have benefits from more of an introduction in the user guide. Didn't really get anywhere with class logs – is it possible to link this with existing classes, or would that be done on Godalming Online? Export was fine and I managed to upload some questions to GOL.

Signed:

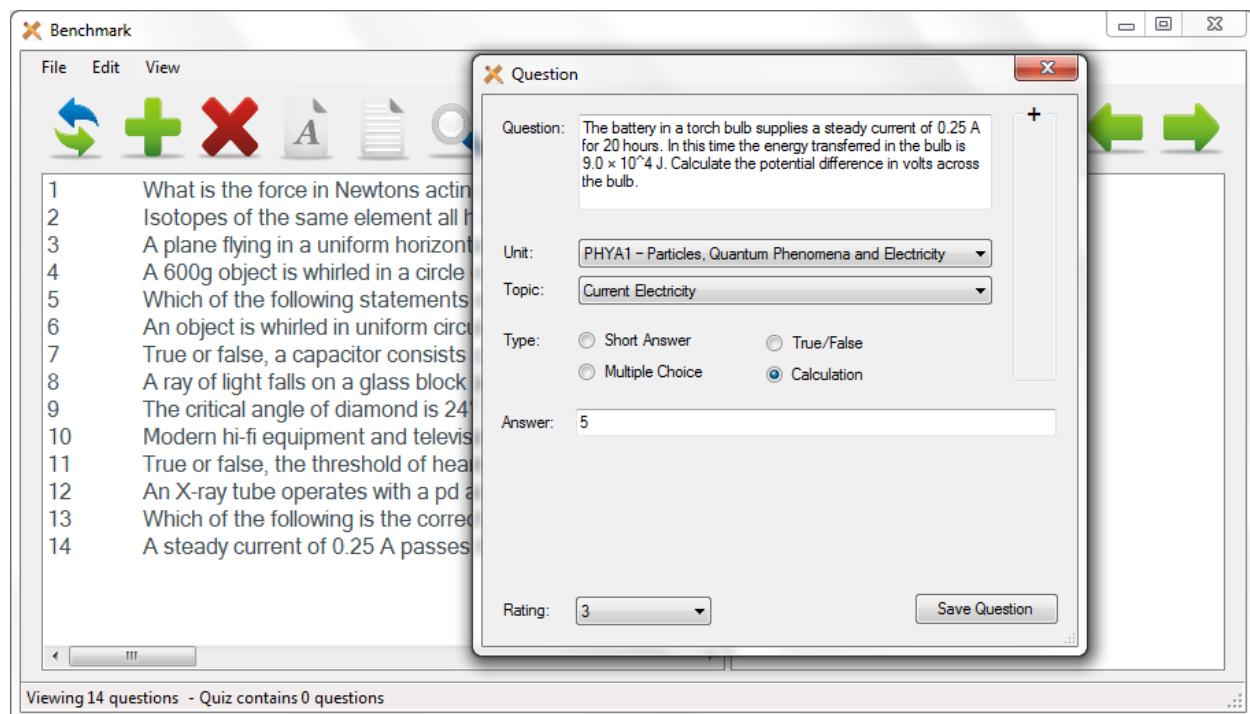


Date: 1/3/13



# Testing Outcome Screenshots

1



The screenshot shows the COMP4 Physics Quiz Generator application. A 'Question' dialog box is open in the foreground, displaying a physics problem about a torch bulb's energy transfer. The background shows a list of 14 questions and a navigation bar.

**Question Dialog Box Content:**

- Question:** The battery in a torch bulb supplies a steady current of 0.25 A for 20 hours. In this time the energy transferred in the bulb is  $9.0 \times 10^4$  J. Calculate the potential difference in volts across the bulb.
- Unit:** PHYA1 - Particles, Quantum Phenomena and Electricity
- Topic:** Current Electricity
- Type:** Calculation (radio button selected)
- Answer:** 5
- Rating:** 3
- Buttons:** Save Question, ...

**Background Interface Elements:**

- Benchmark Bar:** Shows icons for back, forward, search, and other functions.
- File Menu:** File, Edit, View.
- List of Questions:**
  - What is the force in Newtons acting...
  - Isotopes of the same element all ha...
  - A plane flying in a uniform horizont...
  - A 600g object is whirled in a circ...
  - Which of the following statements...
  - An object is whirled in uniform circ...
  - True or false, a capacitor consists...
  - A ray of light falls on a glass block...
  - The critical angle of diamond is 24...
  - Modern hi-fi equipment and televis...
  - True or false, the threshold of heat...
  - An X-ray tube operates with a pd a...
  - Which of the following is the correct...
  - A steady current of 0.25 A passes...
- Status Bar:** Viewing 14 questions - Quiz contains 0 questions

**Benchmark**

File Edit View

What is the force in Newtons acting on a body if its momentum is 15 kg m s⁻¹ and it is moving at 10 m s⁻¹?

Isotopes of the same element all have the same: (Proton number)

A plane flying in a uniform horizontal circle at constant speed

A 600g object is whirled in a circle on the end of a string. If the string is 1m long, what is the tension in the string when the object is moving at 10 m s⁻¹?

Which of the following statements is correct for an object moving in uniform circular motion?

An object is whirled in uniform circular motion in a vertical circle. At the top of the circle, the object is moving at 10 m s⁻¹. What is the minimum value of the tension in the string?

True or false, a capacitor consists of two perpendicular conductors.

A ray of light falls on a glass block and the angle of incidence is 45°. The critical angle of diamond is 24°. What is its refractive index?

The critical angle of diamond is 24°. What is its refractive index?

Modern hi-fi equipment and televisions often have volume controls. True or false, the threshold of hearing is the lowest level of sound that can be heard?

An X-ray tube operates with a pd across the tube of 80 kV. A current of 0.25 mA passes through the tube. What is the power dissipated in the tube?

Which of the following is the correct equation for the work function of a metal?

A steady current of 0.25 A passes through a torch bulb for 6 hours. How much energy is supplied by the battery?

The battery in a torch bulb supplies a steady current of 0.25 A for 6 hours. How much energy is supplied by the battery?

Viewing 15 questions - Quiz contains 0 questions

**Benchmark**

File Edit View

What is the force in Newtons acting on a body if its momentum is 15 kg m s⁻¹ and it is moving at 10 m s⁻¹?

Isotopes of the same element all have the same: (Proton number)

A plane flying in a uniform horizontal circle at constant speed

A 600g object is whirled in a circle on the end of a string. If the string is 1m long, what is the tension in the string when the object is moving at 10 m s⁻¹?

Which of the following statements is correct for an object moving in uniform circular motion?

An object is whirled in uniform circular motion in a vertical circle. At the top of the circle, the object is moving at 10 m s⁻¹. What is the minimum value of the tension in the string?

True or false, a capacitor consists of two perpendicular conductors.

A ray of light falls on a glass block and the angle of incidence is 45°. The critical angle of diamond is 24°. What is its refractive index?

The critical angle of diamond is 24°. What is its refractive index?

Modern hi-fi equipment and televisions often have volume controls. True or false, the threshold of hearing is the lowest level of sound that can be heard?

An X-ray tube operates with a pd across the tube of 80 kV. A current of 0.25 mA passes through the tube. What is the power dissipated in the tube?

Which of the following is the correct equation for the work function of a metal?

A steady current of 0.25 A passes through a torch bulb for 6 hours. How much energy is supplied by the battery?

The battery in a torch bulb supplies a steady current of 0.25 A for 6 hours. How much energy is supplied by the battery?

**Question**

Question:

Unit: PHYA1 – Particles, Quantum Phenomena and Electricity

Topic: Particles and Radiation

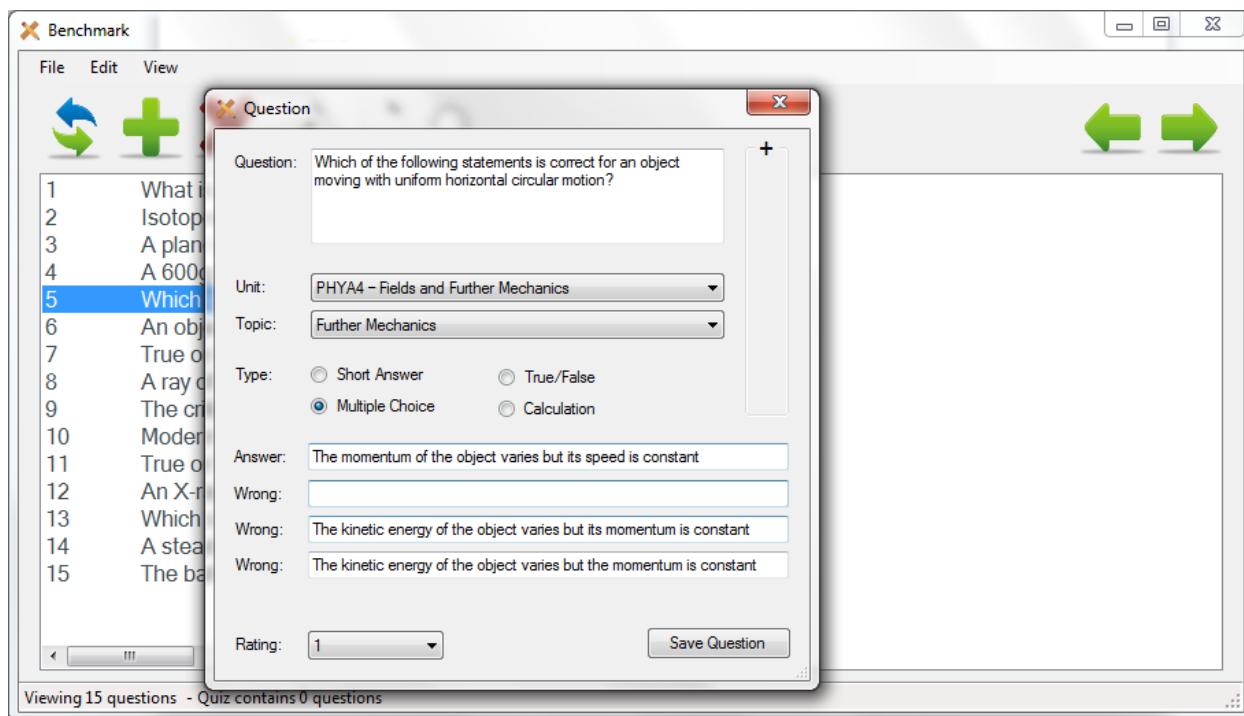
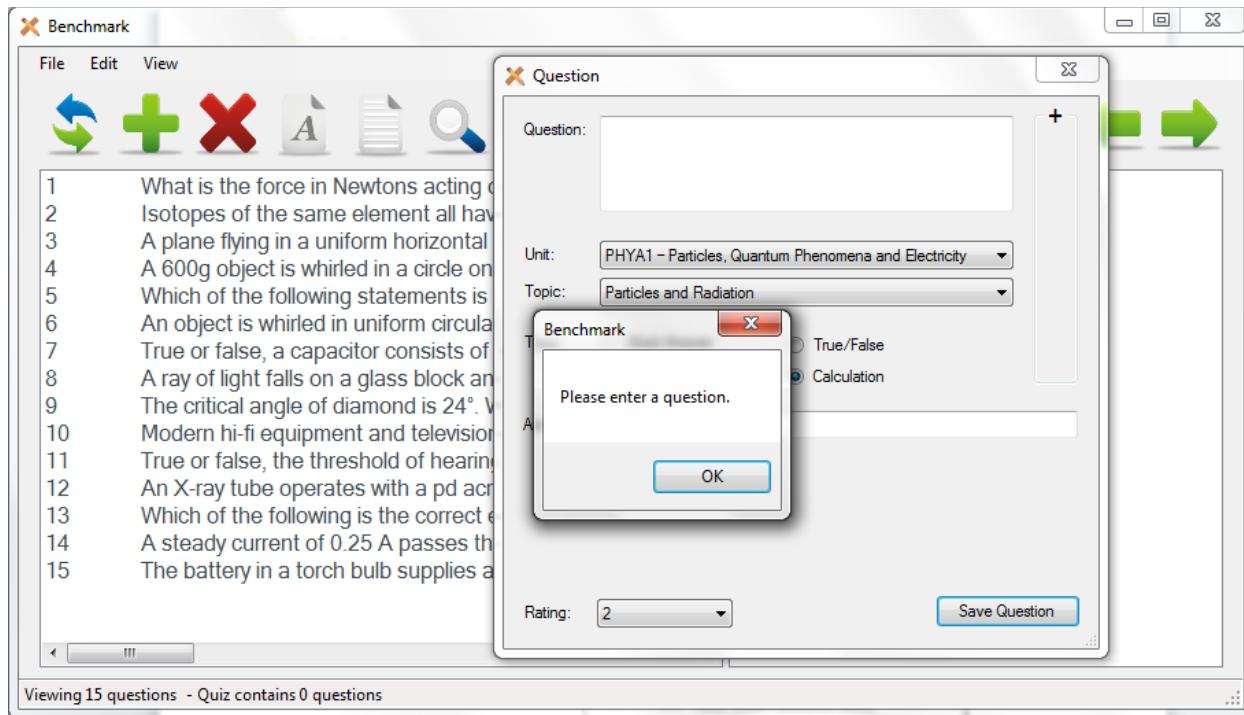
Type:  Short Answer  True/False  
 Multiple Choice  Calculation

Answer: 75

Rating: 2

Save Question

Viewing 15 questions - Quiz contains 0 questions



**Benchmark**

File Edit View

Question: Which of the following statements is correct for an object moving with uniform horizontal circular motion?

Unit: PHYSICS

Topic: Fundamentals

Type: Multiple Choice

Answer: The object moves in a straight line at constant speed.

Wrong: An object is whirled in uniform circular motion.

Wrong: The kinetic energy of the object varies but its momentum is constant.

Wrong: The speed of the object varies but the momentum is constant.

Rating: 1

**Question**

Please submit three incorrect answers.

**OK**

Viewing 15 questions - Quiz contains 0 questions

**Benchmark**

File Edit View

Question: What is 5+3?

Unit: PHYA1 – Particles, Quantum Phenomena and Electricity

Topic: Particles and Radiation

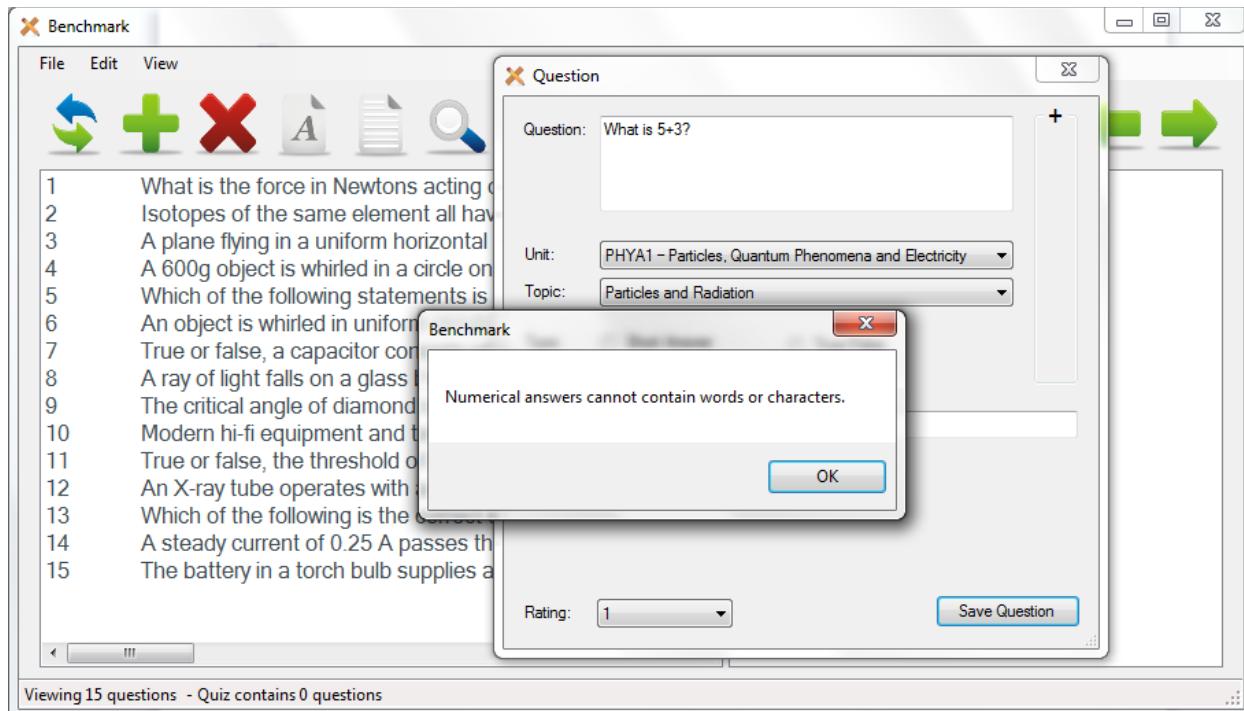
Type: Short Answer

Answer: eight

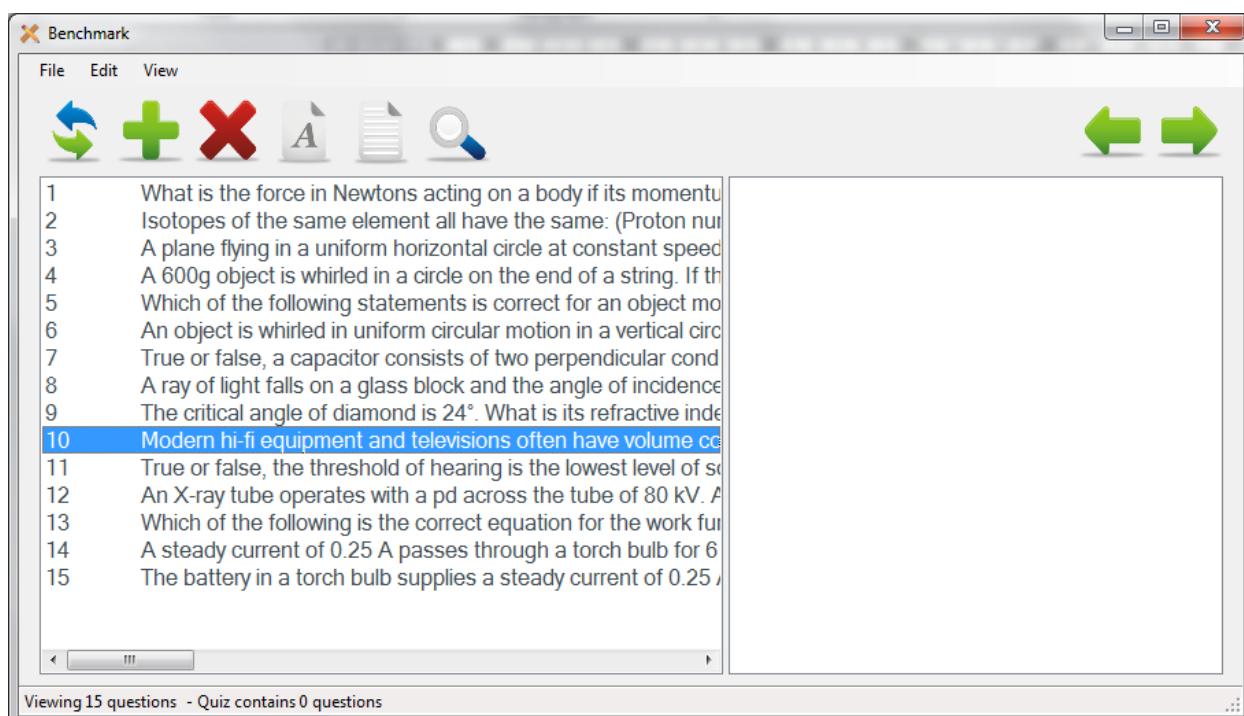
Rating: 1

**Question**

Viewing 15 questions - Quiz contains 0 questions



4



**Benchmark**

File Edit View

1 What is the force in Newtons acting on a body if its momentum is 10 kg m s⁻¹ and it has a mass of 2 kg?  
 2 Isotopes of the same element all have the same:  
 3 A plane flying in a uniform horizontal circle at constant speed  
 4 A 600g object is whirled in a circle on the end of a string 1.5 m long.  
 5 Which of the following statements is correct for a capacitor?  
 6 An object is whirled in uniform circular motion in a vertical circle.  
 7 True or false, a capacitor consists of two parallel plates.  
 8 A ray of light falls on a glass block and the angle of refraction is 30°.  
 9 The critical angle of diamond is 24°. What is its refractive index?  
 10 Modern hi-fi equipment and televisions often have volume controls which allow the sound volume to be increased in steps. If each of these steps produces an increase in the sound intensity level of 2.0 dB, calculate the ratio by which the sound intensity increases.  
 11 True or false, the threshold of hearing is the lowest level of sound that can be heard.  
 12 An X-ray tube operates with a pd across the tube of 80 kV. A current of 0.25 mA passes through the tube.  
 13 Which of the following is the correct equation for the work function of a metal?  
 14 A steady current of 0.25 A passes through a torch bulb for 6 minutes.  
 15 The battery in a torch bulb supplies a steady current of 0.25 A.

**Question**

Question: Modern hi-fi equipment and televisions often have volume controls which allow the sound volume to be increased in steps. If each of these steps produces an increase in the sound intensity level of 2.0 dB, calculate the ratio by which the sound intensity increases.

Unit: PHYA5B – Medical Physics

Topic: Physics of the Ear

Type:  Calculation  Short Answer  True/False  Multiple Choice

Answer: 1.58

Rating: 3

Save Question

Viewing 15 questions - Quiz contains 0 questions

**Benchmark**

File Edit View

1 What is the force in Newtons acting on a body if its momentum is 10 kg m s⁻¹ and it has a mass of 2 kg?  
 2 Isotopes of the same element all have the same:  
 3 A plane flying in a uniform horizontal circle at constant speed  
 4 A 600g object is whirled in a circle on the end of a string 1.5 m long.  
 5 Which of the following statements is correct for a capacitor?  
 6 An object is whirled in uniform circular motion in a vertical circle.  
 7 True or false, a capacitor consists of two parallel plates.  
 8 A ray of light falls on a glass block and the angle of refraction is 30°.  
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 14 A steady current of 0.25 A passes through a torch bulb for 6 minutes.  
 15 The battery in a torch bulb supplies a steady current of 0.25 A.

**Benchmark**

Please select a question.

OK

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6

**Benchmark**

File Edit View

What is the force in Newtons acting on a body if its momentum? Isotopes of the same element all have the same: (Proton number) A plane flying in a uniform horizontal circle at constant speed. A 600g object is whirled in a circle on the end of a string. If the Which of the following statements is correct for an object moving An object is whirled in uniform circular motion in a vertical circle. True or false, a capacitor consists of two perpendicular condensers. A ray of light falls on a glass block and the angle of incidence is The critical angle of diamond is 24°. What is its refractive index? Modern hi-fi equipment and televisions often have volume controls. True or false, the threshold of hearing is the lowest level of sound. An X-ray tube operates with a pd across the tube of 80 kV. A Which of the following is the correct equation for the work function? A steady current of 0.25 A passes through a torch bulb for 6 hours. The battery in a torch bulb supplies a steady current of 0.25 A. Test question (Will be deleted) [Particles and Radiation, 1]

Viewing 16 questions - Quiz contains 0 questions

**Benchmark**

File Edit View

What is the force in Newtons acting on a body if its momentum? Isotopes of the same element all have the same: (Proton number) A plane flying in a uniform horizontal circle at constant speed. A 600g object is whirled in a circle on the end of a string. If the Which of the following statements is correct for an object moving An object is whirled in uniform circular motion in a vertical circle. True or false, a capacitor consists of two perpendicular condensers. A ray of light falls on a glass block and the angle of incidence is The critical angle of diamond is 24°. What is its refractive index? Modern hi-fi equipment and televisions often have volume controls. True or false, the threshold of hearing is the lowest level of sound. An X-ray tube operates with a pd across the tube of 80 kV. A Which of the following is the correct equation for the work function? A steady current of 0.25 A passes through a torch bulb for 6 hours. The battery in a torch bulb supplies a steady current of 0.25 A. Test question (Will be deleted) [Particles and Radiation, 1]

**Benchmark**

Are you sure you want delete this question?

Yes No

Viewing 16 questions - Quiz contains 0 questions

**Benchmark**

File Edit View

What is the force in Newtons acting on a body if its momentum is doubled? (Assume mass is constant.)  
 Isotopes of the same element all have the same: (Proton number)  
 A plane flying in a uniform horizontal circle at constant speed has a centripetal acceleration.  
 A 600g object is whirled in a circle on the end of a string. If the string breaks, the object will move in a straight line.  
 Which of the following statements is correct for an object moving in uniform circular motion?  
 An object is whirled in uniform circular motion in a vertical circle. At the top of the circle, the object is in free fall.  
 True or false, a capacitor consists of two perpendicular conductors.  
 A ray of light falls on a glass block and the angle of incidence is greater than the angle of refraction.  
 The critical angle of diamond is  $24^\circ$ . What is its refractive index?  
 Modern hi-fi equipment and televisions often have volume controls.  
 True or false, the threshold of hearing is the lowest level of sound.  
 An X-ray tube operates with a pd across the tube of 80 kV. A steady current of 0.25 A passes through it.  
 Which of the following is the correct equation for the work function of a metal?  
 A steady current of 0.25 A passes through a torch bulb for 6 hours.  
 The battery in a torch bulb supplies a steady current of 0.25 A.

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**Benchmark**

File Edit View

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 The battery in a torch bulb supplies a steady current of 0.25 A.

Please select a question.

OK

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8

**Benchmark**

File Edit View

← →

1 What is the force in Newtons acting on a body if its momentum  
 2 Isotopes of the same element all have the same: (Proton nucl  
 3 A plane flying in a uniform horizontal circle at constant speed  
 4 A 600g object is whirled in a circle on the end of a string. If th  
 5 Which of the following statements is correct for an object mo  
 6 An object is whirled in uniform circular motion in a vertical circ  
 7 True or false, a capacitor consists of two perpendicular cond  
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 9 The critical angle of diamond is  $24^\circ$ . What is its refractive inde  
 10 Modern hi-fi equipment and televisions often have volume co  
 11 True or false, the threshold of hearing is the lowest level of so  
 12 An X-ray tube operates with a pd across the tube of 80 kV. A  
 13 Which of the following is the correct equation for the work ful  
 14 A steady current of 0.25 A passes through a torch bulb for 6  
 15 The battery in a torch bulb supplies a steady current of 0.25 /

A ray of light falls on a glass block and the angle of incidence

Viewing 15 questions - Quiz contains 1 questions

9

**Benchmark**

File Edit View

← →

1 What is the force in Newtons acting on a body if its momentum  
 2 Isotopes of the same element all have the same: (Proton nucl  
 3 A plane flying in a uniform horizontal circle at constant speed  
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 13 Which of the following is the correct equation for the work ful  
 14 A steady current of 0.25 A passes through a torch bulb for 6  
 15 The battery in a torch bulb supplies a steady current of 0.25 /

Please select a question and try again.

OK

Viewing 15 questions - Quiz contains 0 questions

10

**Benchmark**

File Edit View

1 What is the force in Newtons acting on a body if its momentum? Isotopes of the same element all have the same: (Proton number) A plane flying in a uniform horizontal circle at constant speed A 600g object is whirled in a circle on the end of a string. If the Which of the following statements is correct for an object moving An object is whirled in uniform circular motion in a vertical circ True or false, a capacitor consists of two parallel plates A ray of light falls on a glass block and the angle of incidence The critical angle of diamond is 24°. What is its refractive index Modern hi-fi equipment and televisions often have volume controls True or false, the threshold of hearing is the lowest level of sound An X-ray tube operates with a pd across the tube of 80 kV. A Which of the following is the correct equation for the work ful A steady current of 0.25 A passes through a torch bulb for 6 The battery in a torch bulb supplies a steady current of 0.25 /

What is the force in Newtons acting on a body if its momentum?

**Benchmark**

Error. This question is already in the quiz.

OK

Viewing 15 questions - Quiz contains 1 questions

**Benchmark**

File Edit View

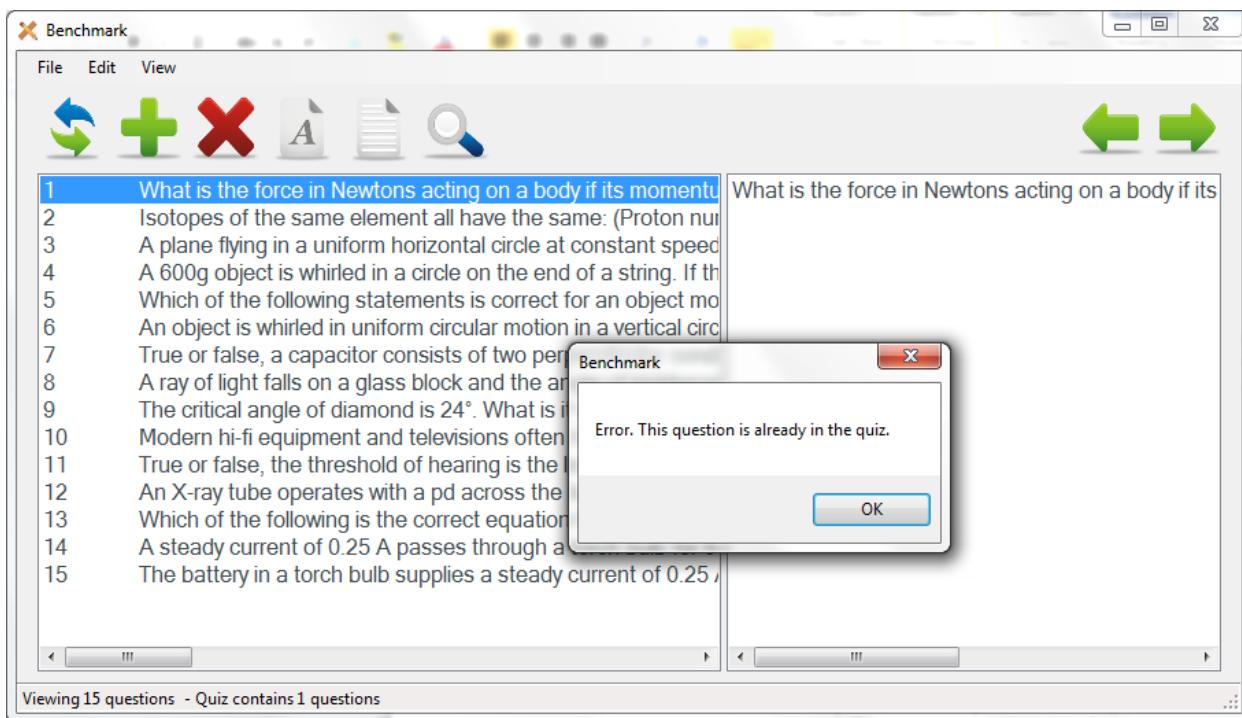
1 What is the force in Newtons acting on a body if its momentum? Isotopes of the same element all have the same: (Proton number) A plane flying in a uniform horizontal circle at constant speed A 600g object is whirled in a circle on the end of a string. If the Which of the following statements is correct for an object moving An object is whirled in uniform circular motion in a vertical circ True or false, a capacitor consists of two parallel plates A ray of light falls on a glass block and the angle of incidence The critical angle of diamond is 24°. What is its refractive index Modern hi-fi equipment and televisions often have volume controls True or false, the threshold of hearing is the lowest level of sound An X-ray tube operates with a pd across the tube of 80 kV. A Which of the following is the correct equation for the work ful A steady current of 0.25 A passes through a torch bulb for 6 The battery in a torch bulb supplies a steady current of 0.25 /

What is the force in Newtons acting on a body if its momentum?

What is the force in Newtons acting on a body if its momentum?

Viewing 16 questions - Quiz contains 2 questions

11



1 What is the force in Newtons acting on a body if its momentum is doubled?  
 2 Isotopes of the same element all have the same: (Proton number)  
 3 A plane flying in a uniform horizontal circle at constant speed  
 4 A 600g object is whirled in a circle on the end of a string. If the string is 1m long, what is the centripetal force?  
 5 Which of the following statements is correct for an object moving in uniform circular motion?  
 6 An object is whirled in uniform circular motion in a vertical circle.  
 7 True or false, a capacitor consists of two parallel plates.  
 8 A ray of light falls on a glass block and the angle of refraction is 30°. What is the critical angle of diamond?  
 9 The critical angle of diamond is 24°. What is the refractive index of diamond?  
 10 Modern hi-fi equipment and televisions often contain transistors.  
 11 True or false, the threshold of hearing is the lowest level of sound?  
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 15 The battery in a torch bulb supplies a steady current of 0.25 A.

What is the force in Newtons acting on a body if its momentum is doubled?

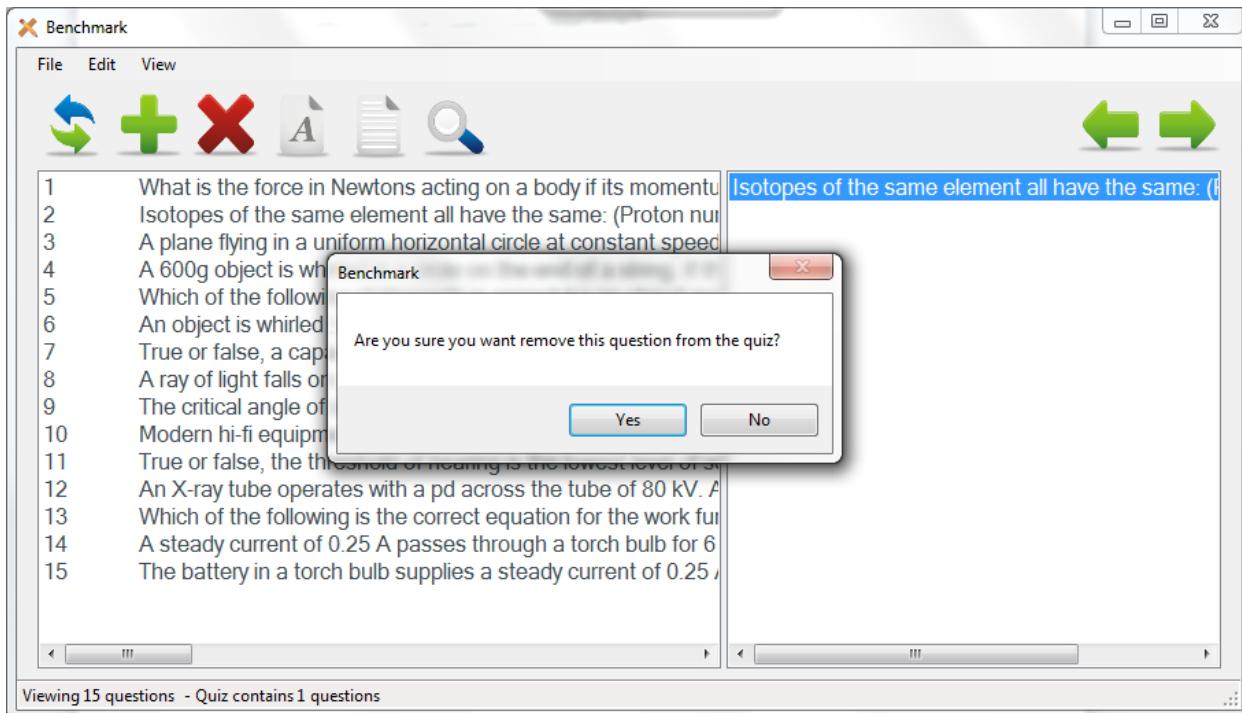
**Benchmark**

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OK

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12



1 What is the force in Newtons acting on a body if its momentum is doubled?  
 2 Isotopes of the same element all have the same: (Proton number)  
 3 A plane flying in a uniform horizontal circle at constant speed  
 4 A 600g object is whirled in a circle on the end of a string. If the string is 1m long, what is the centripetal force?  
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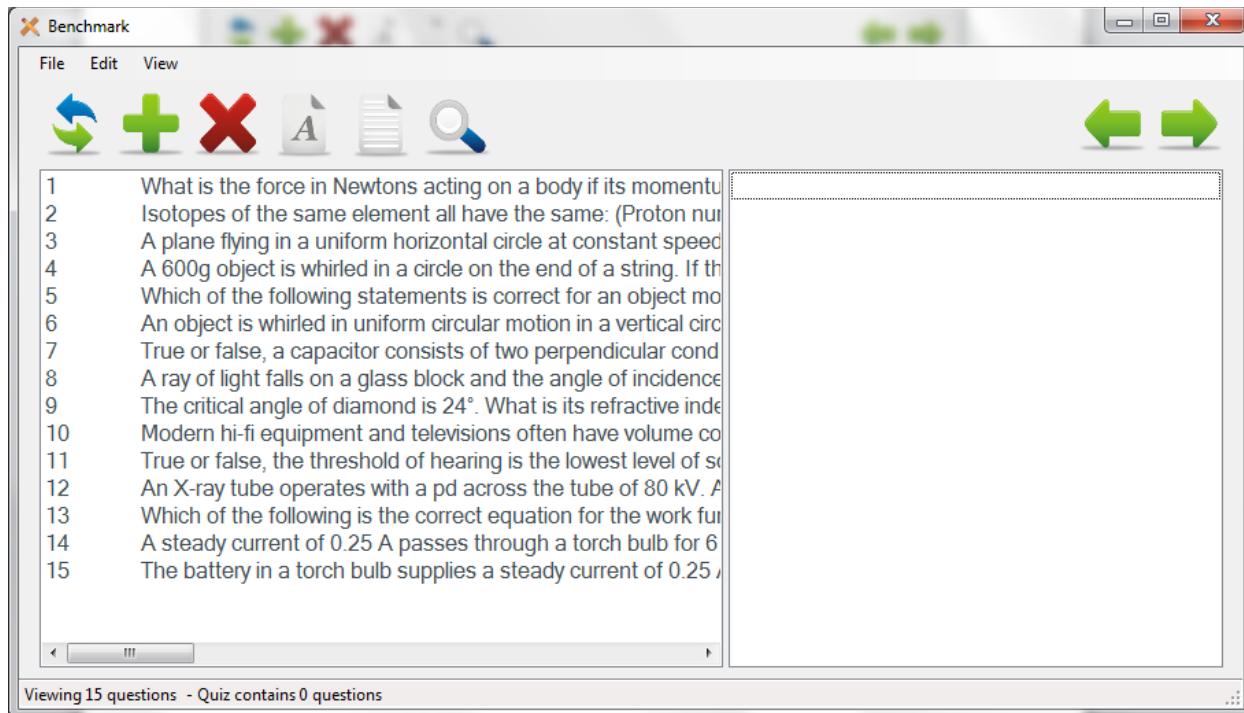
Isotopes of the same element all have the same: (Proton number)

**Benchmark**

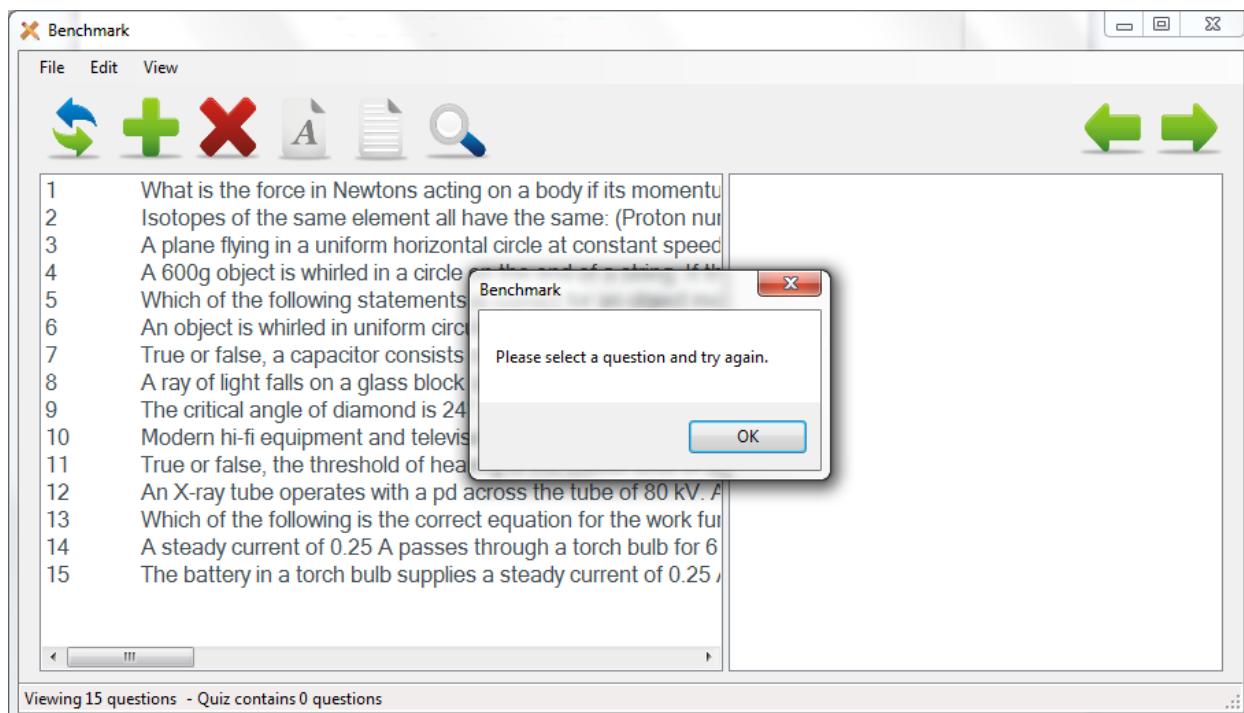
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Yes No

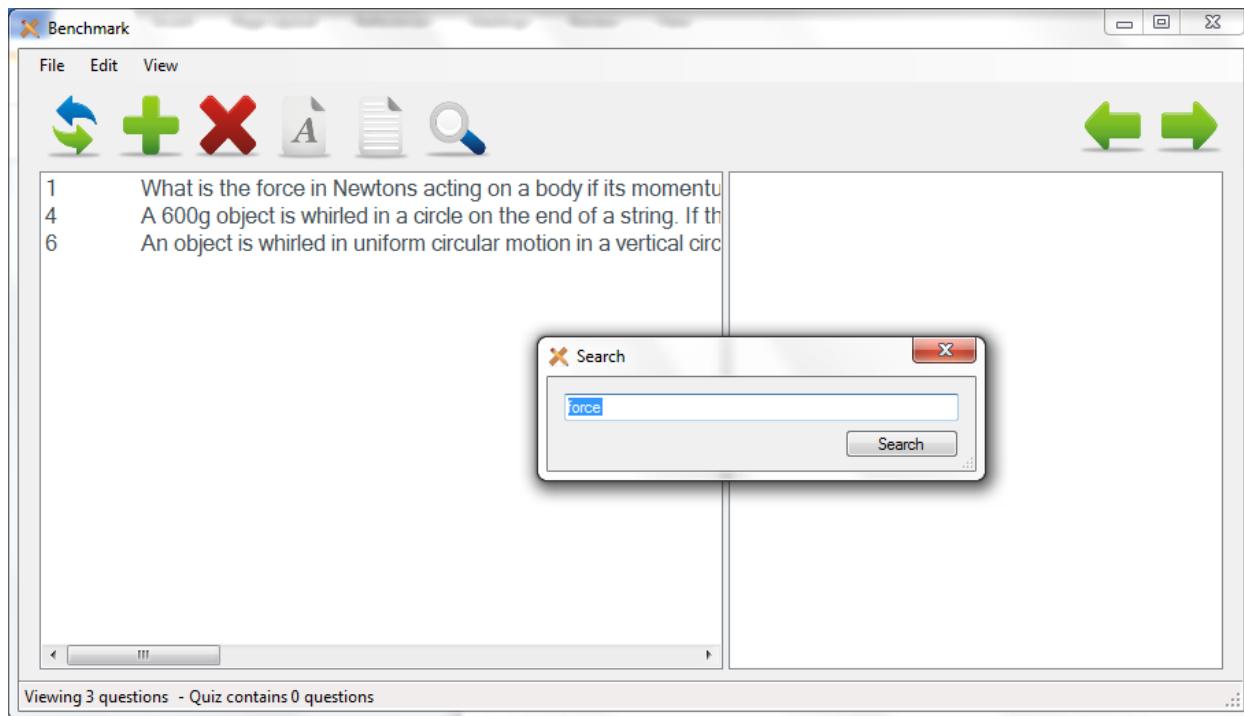
Viewing 15 questions - Quiz contains 1 questions



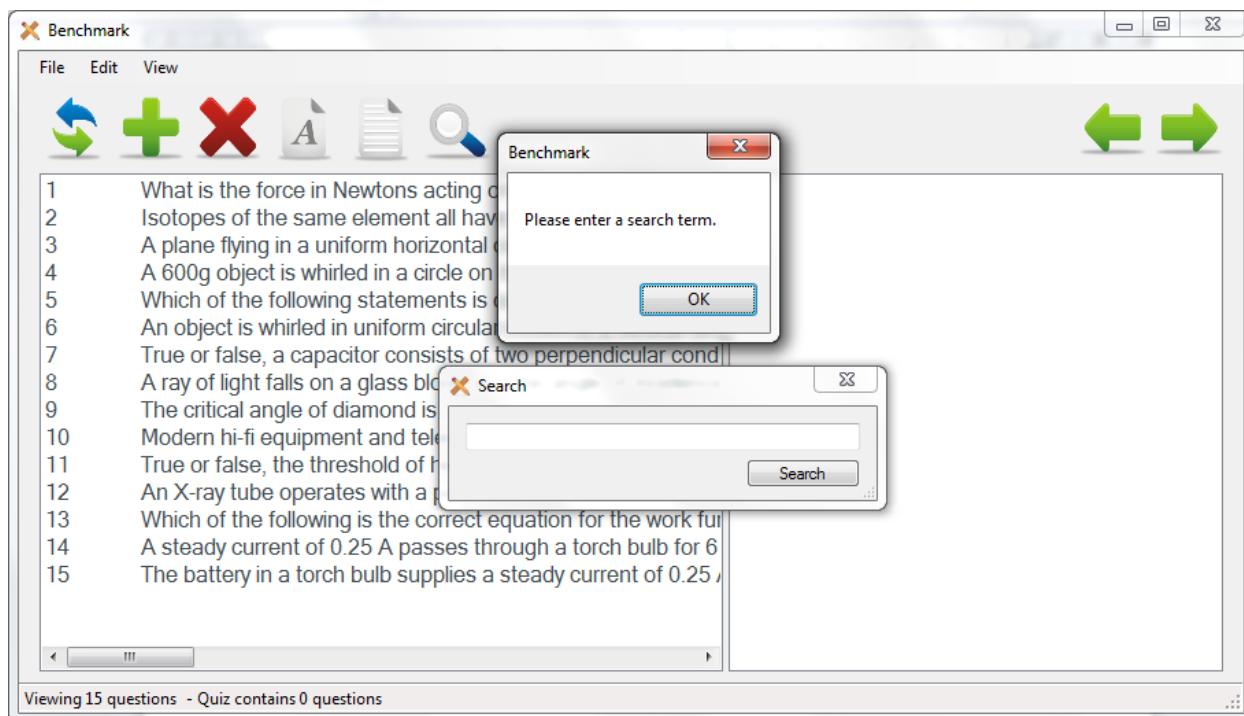
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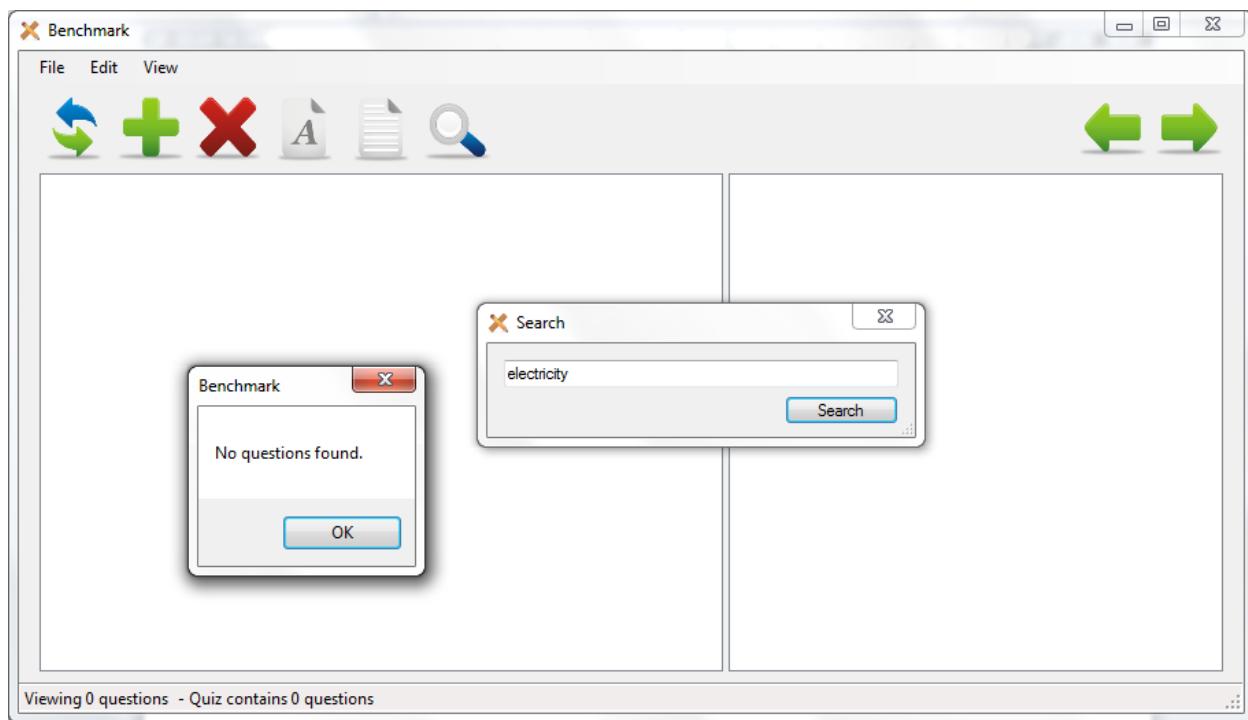
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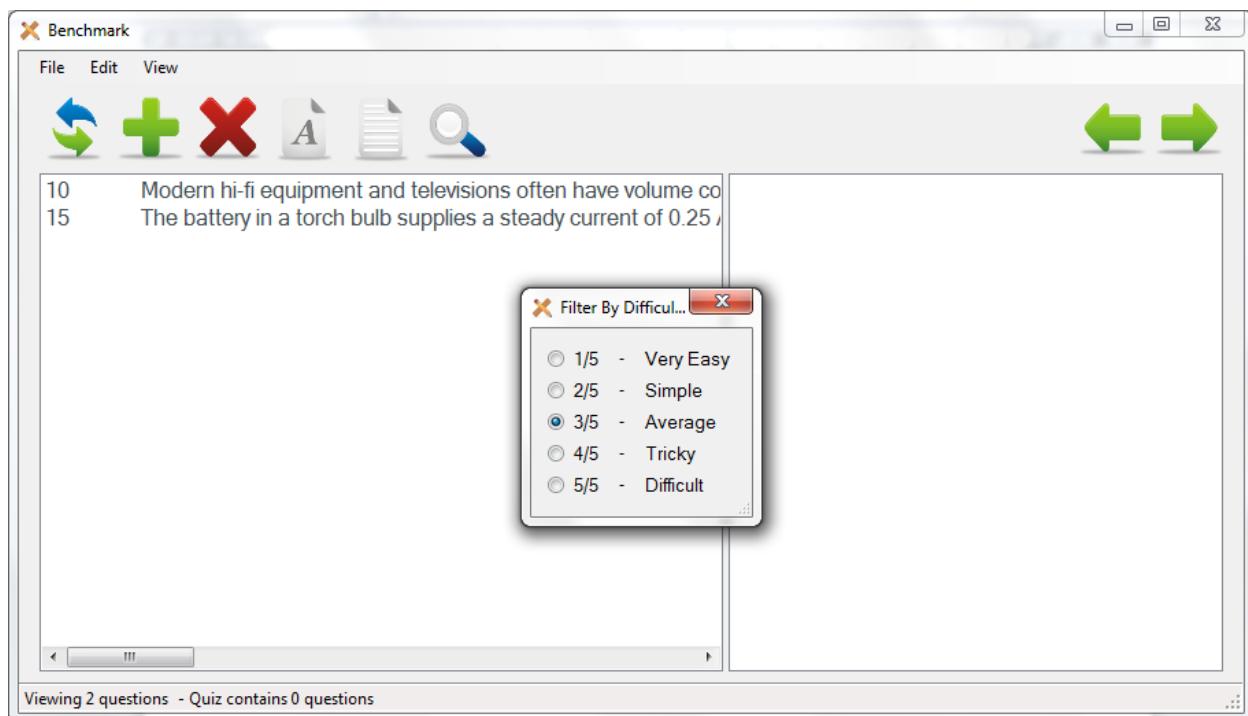
15



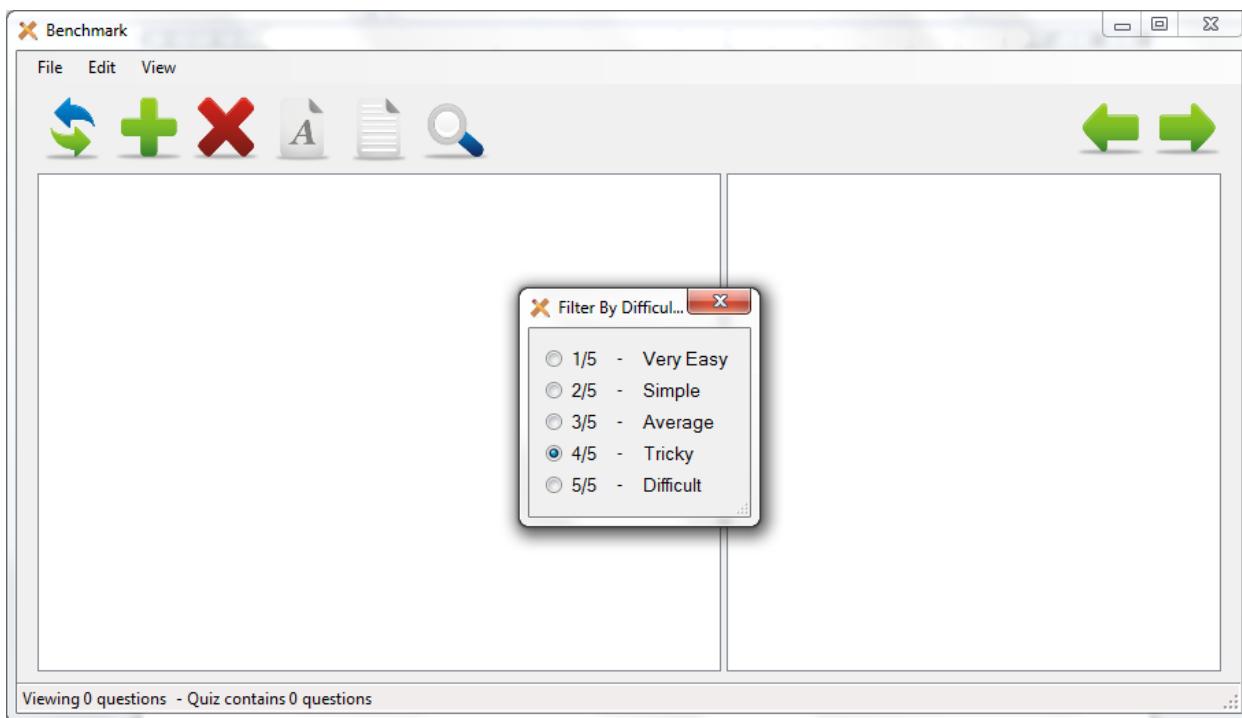
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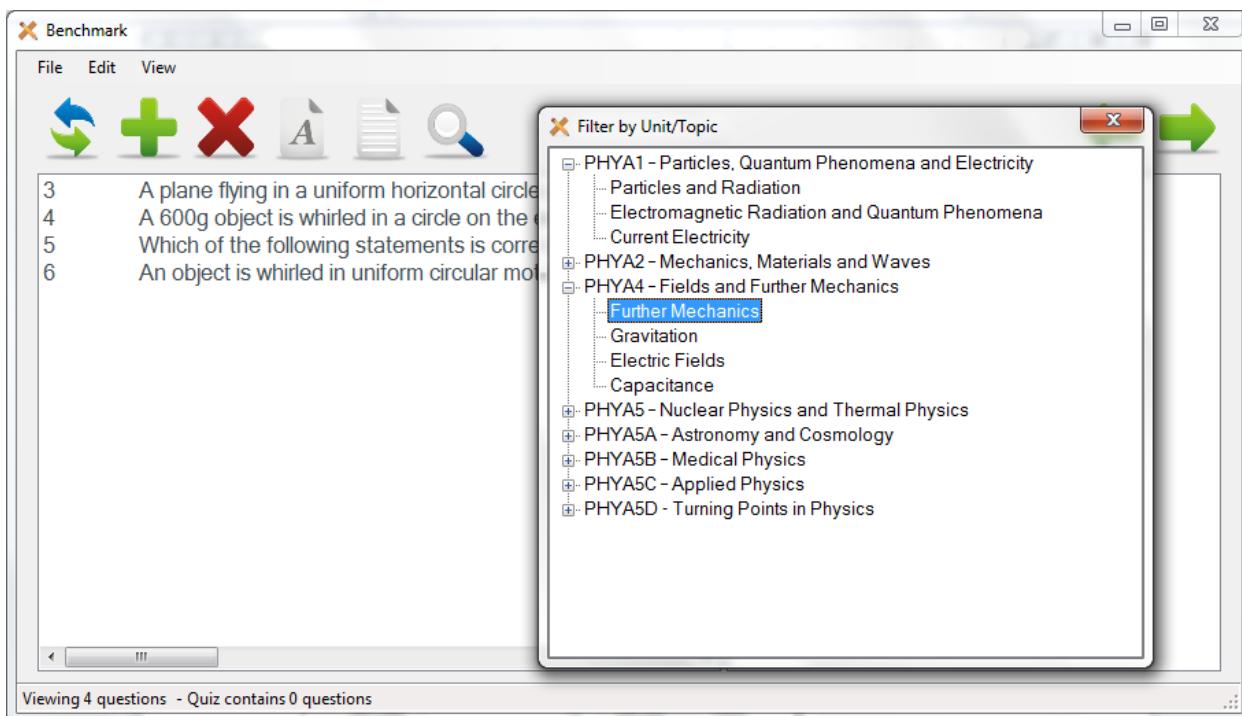
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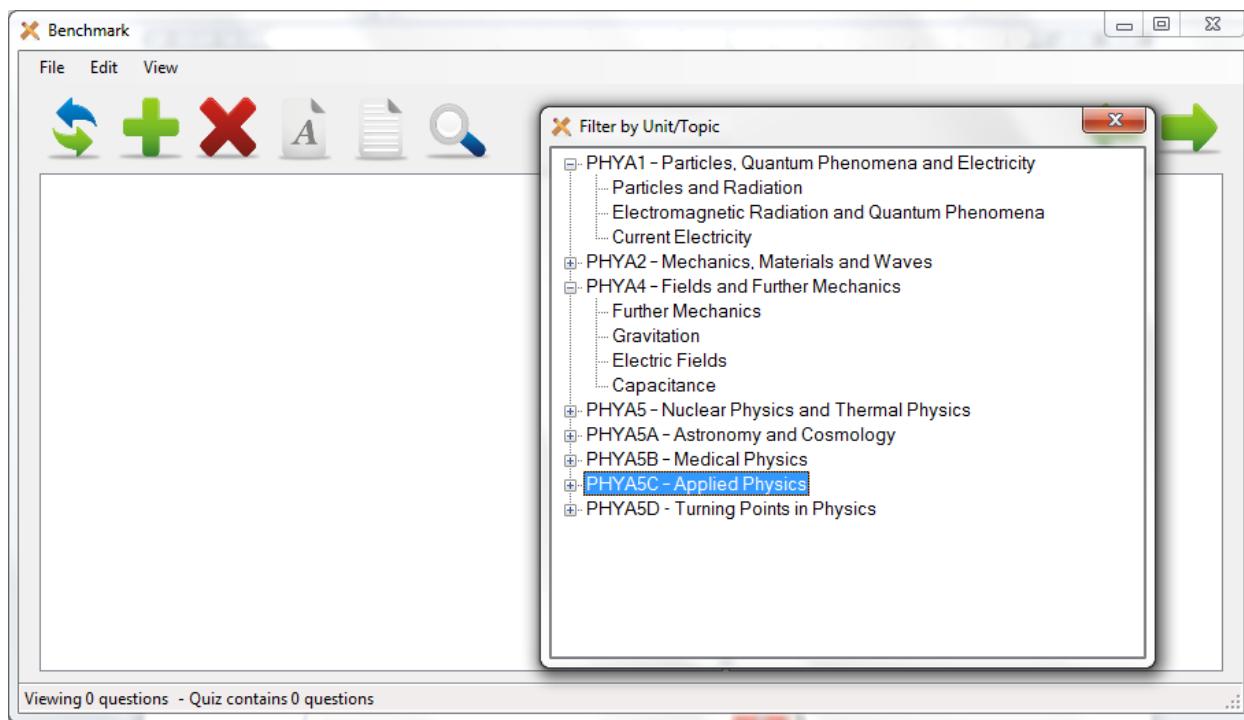
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19



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21

**Filter By Type**

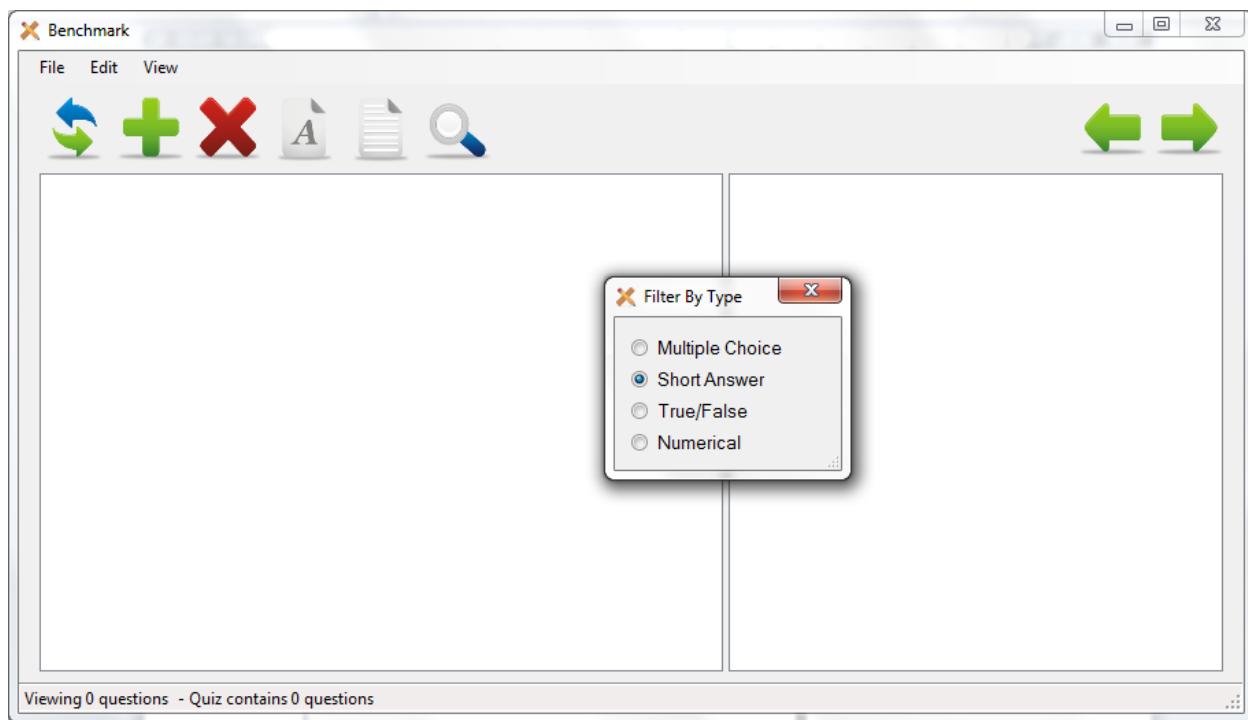
Multiple Choice

Short Answer

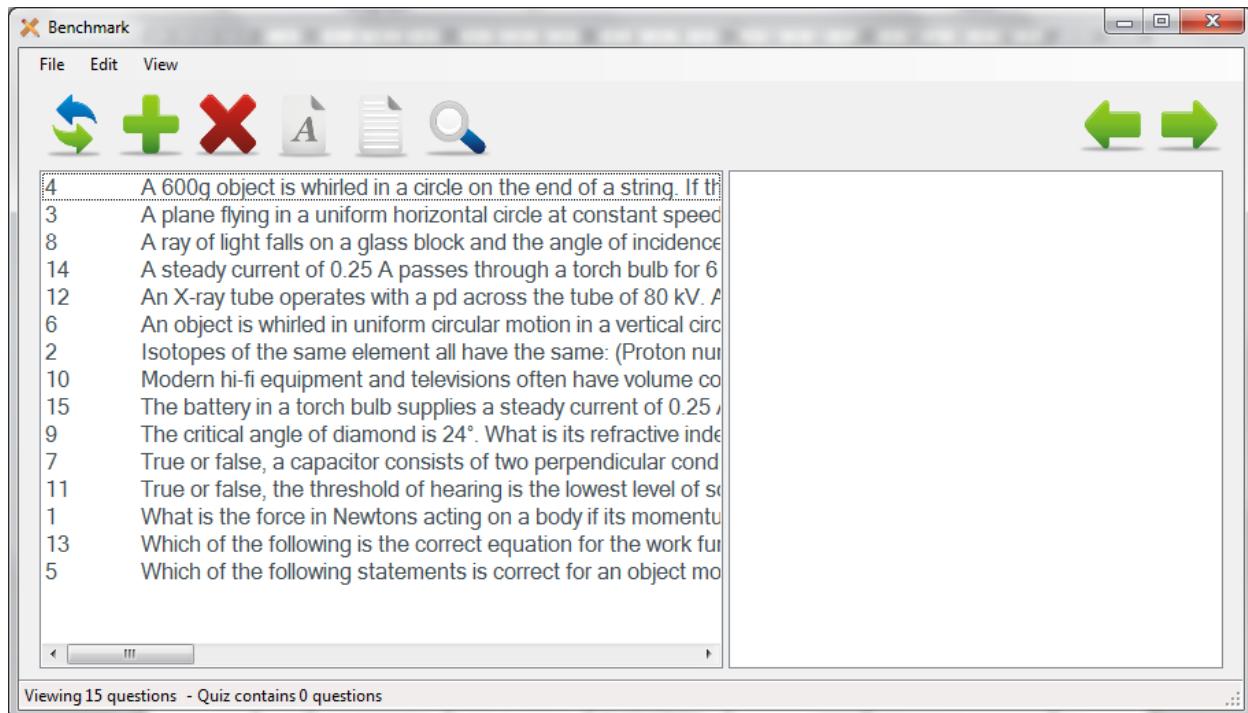
True/False

Numerical

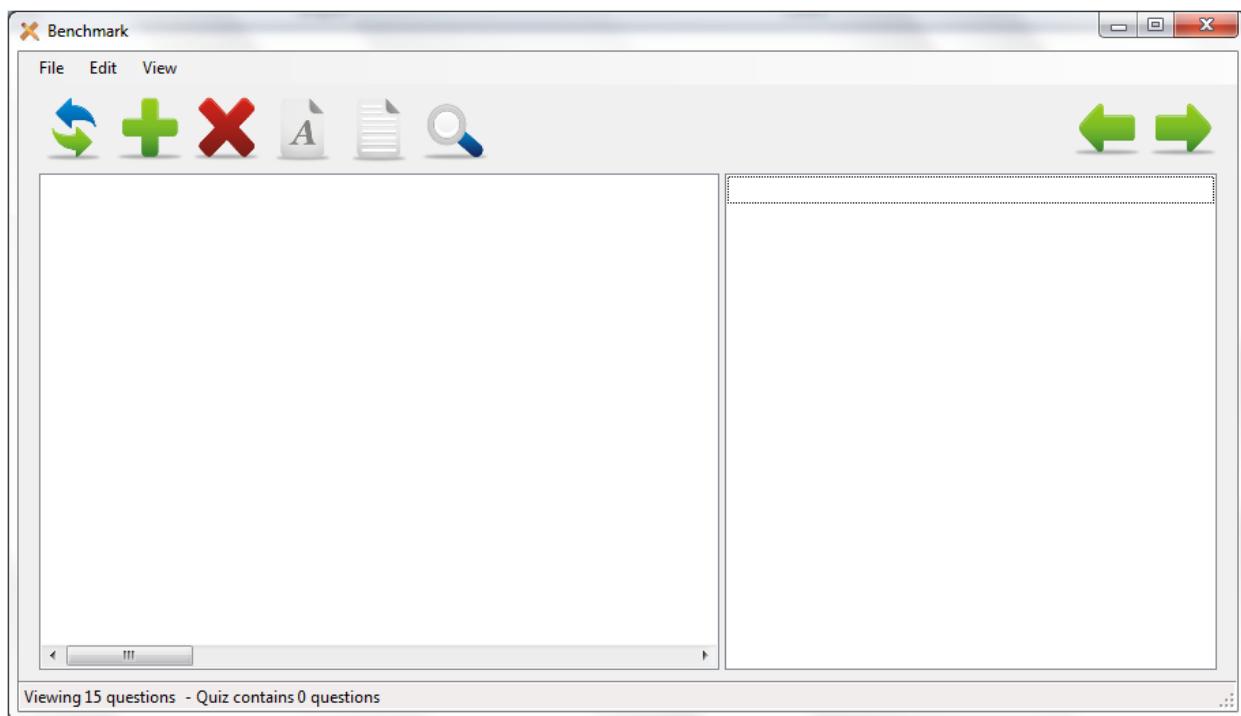
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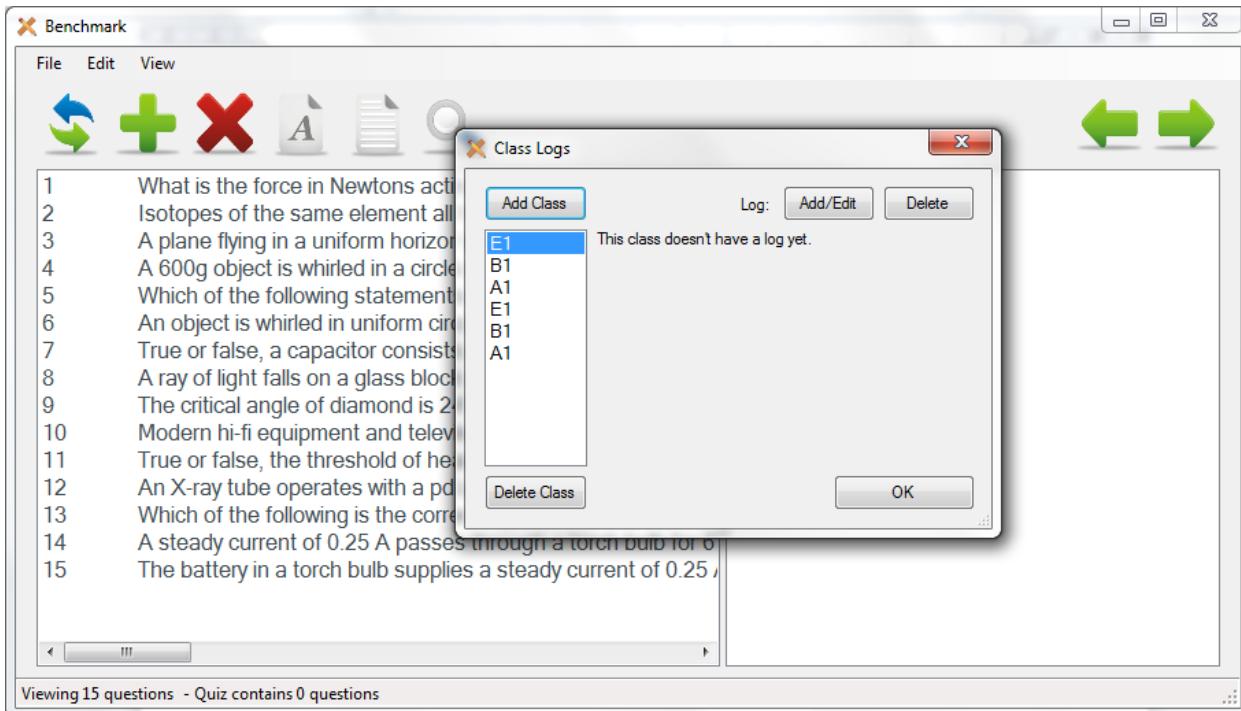
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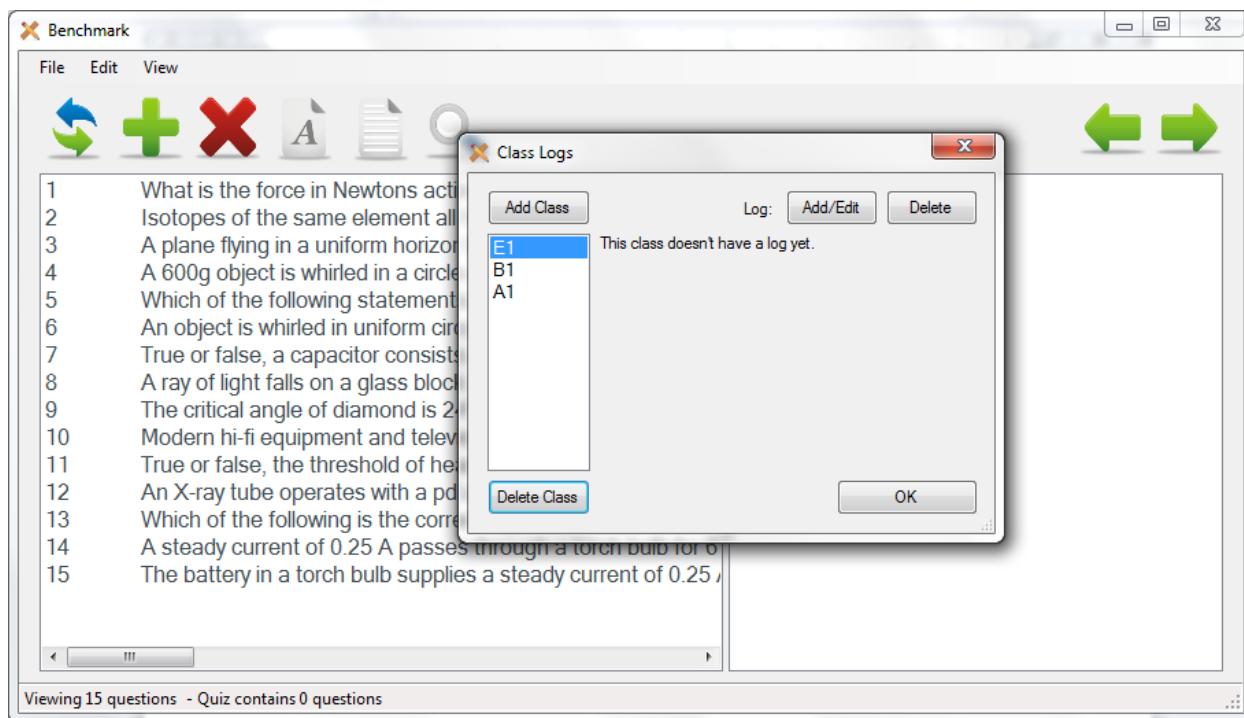
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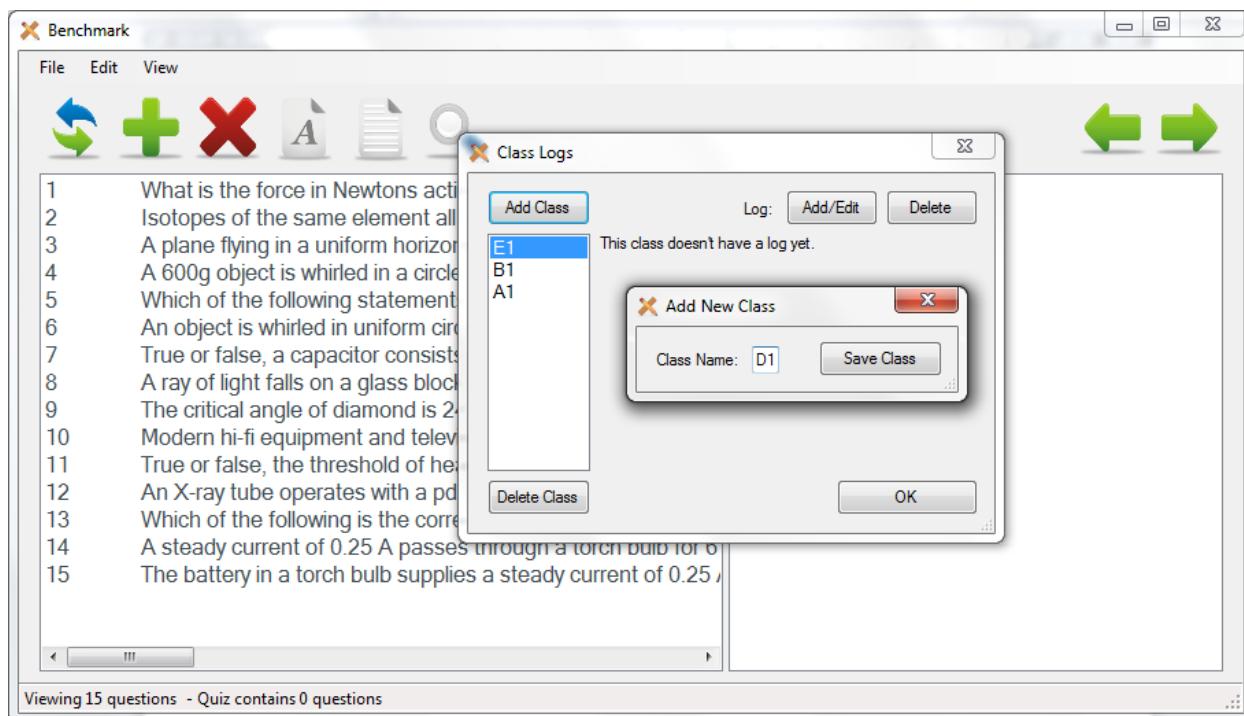
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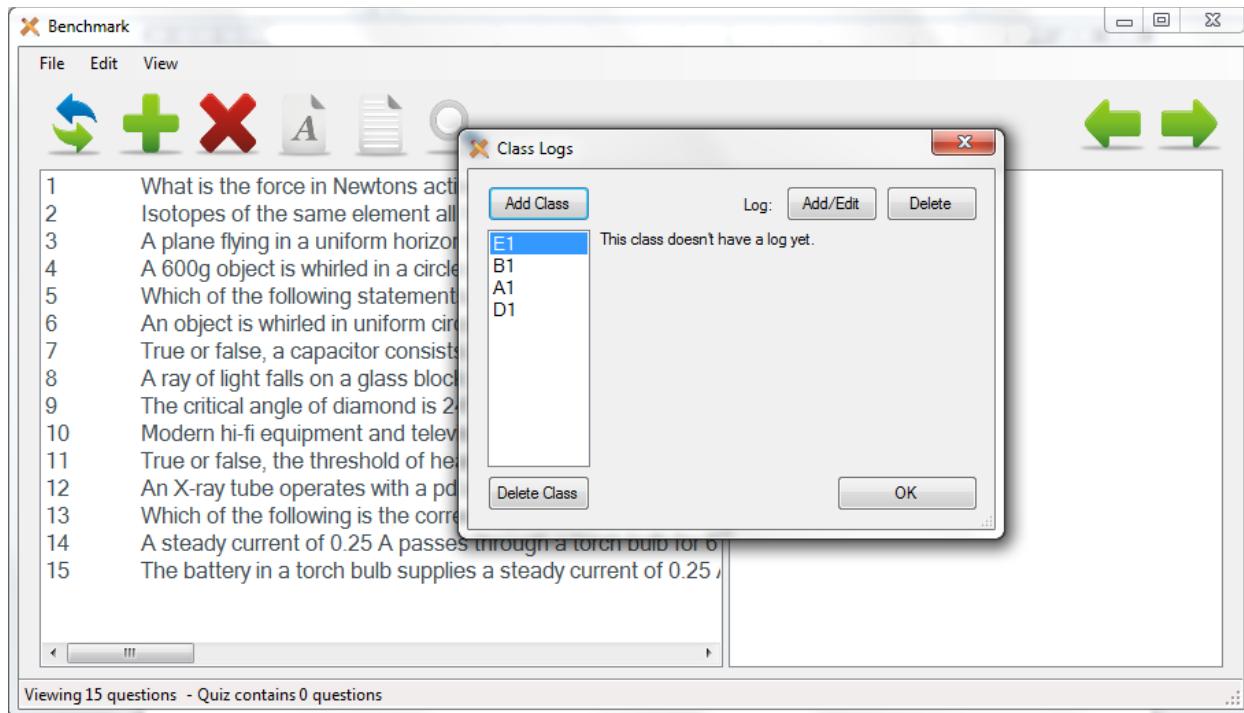


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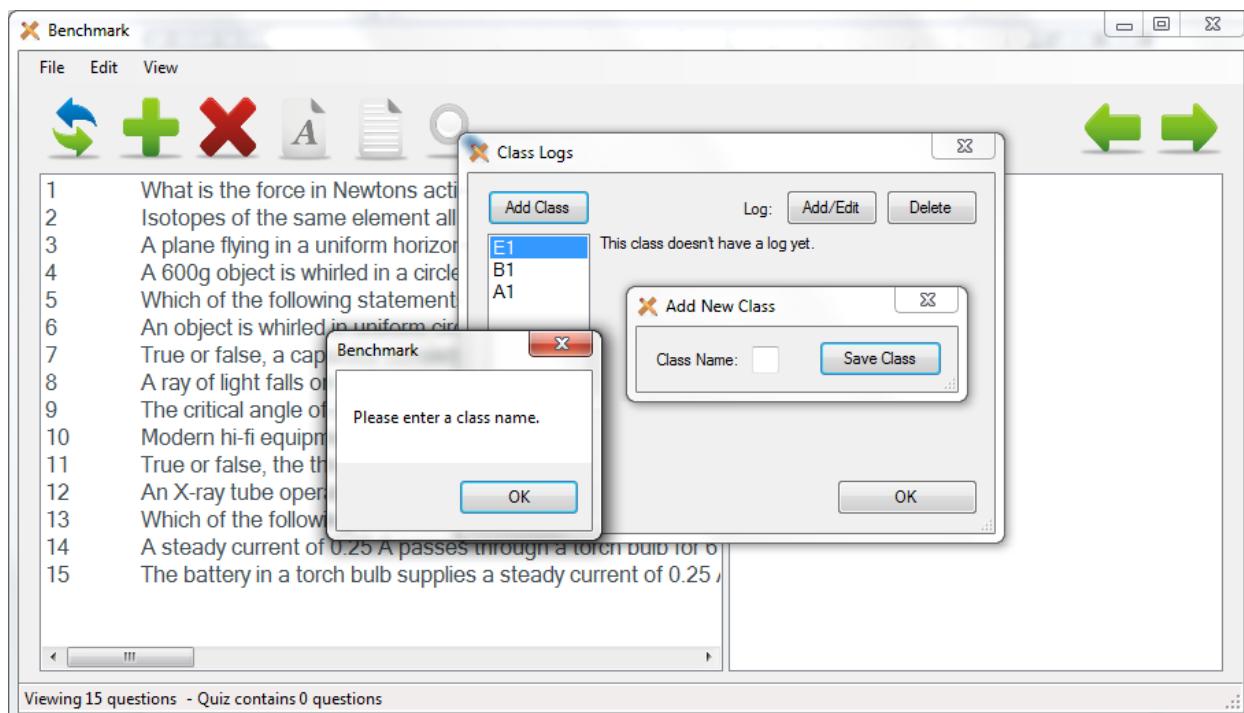


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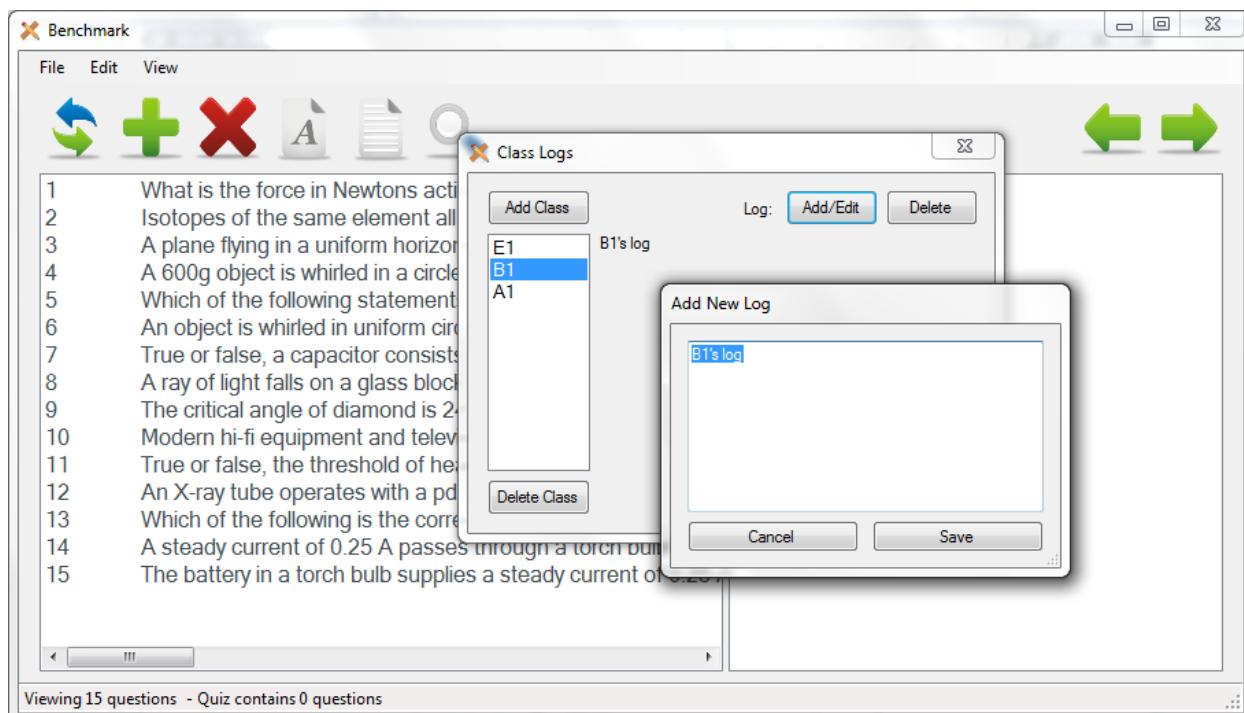
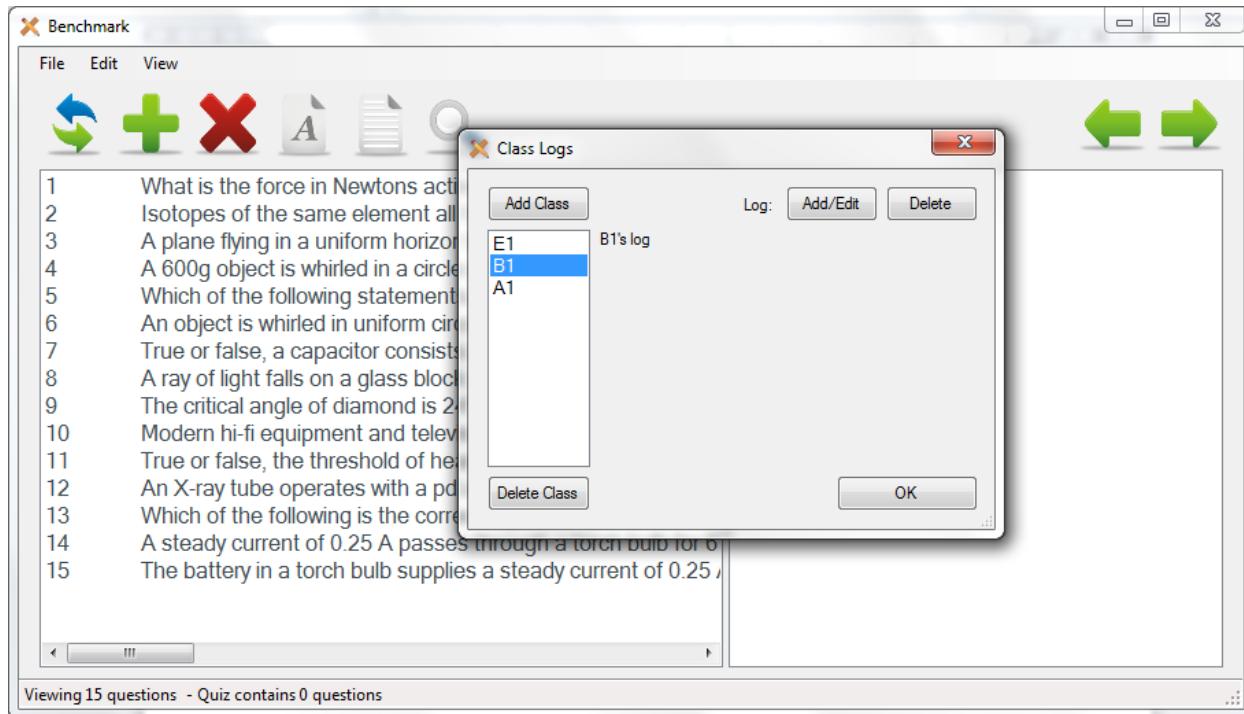




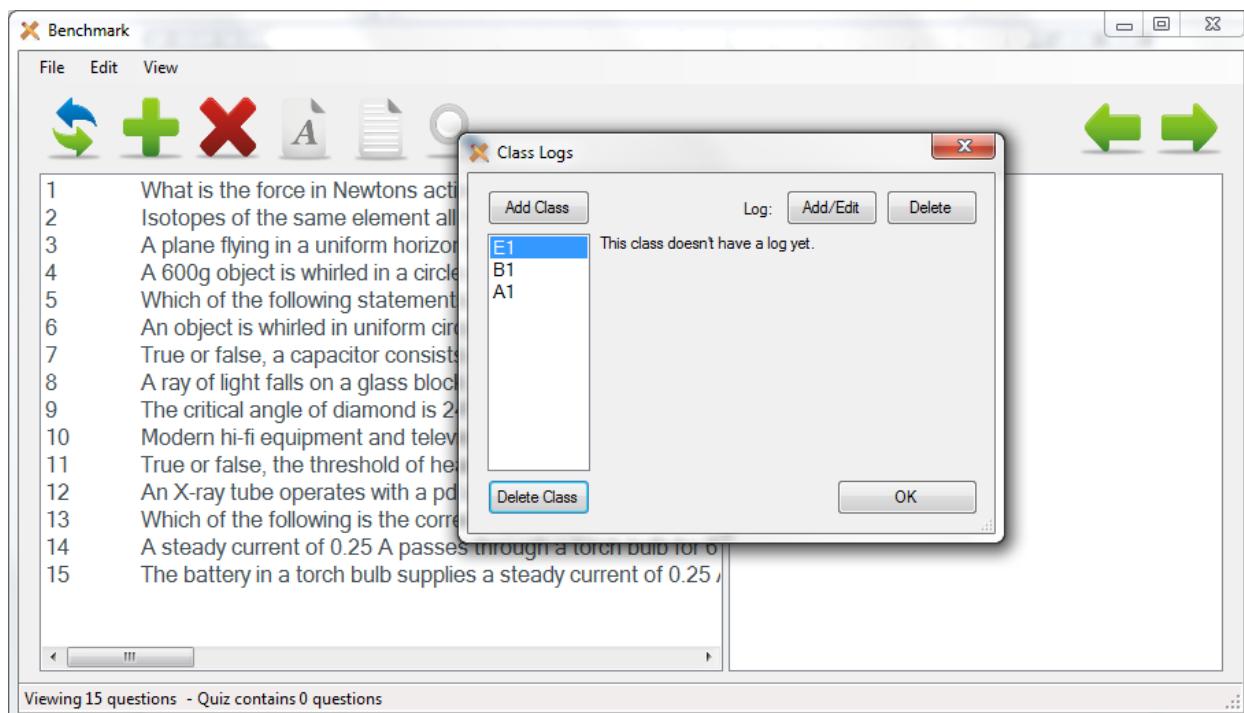
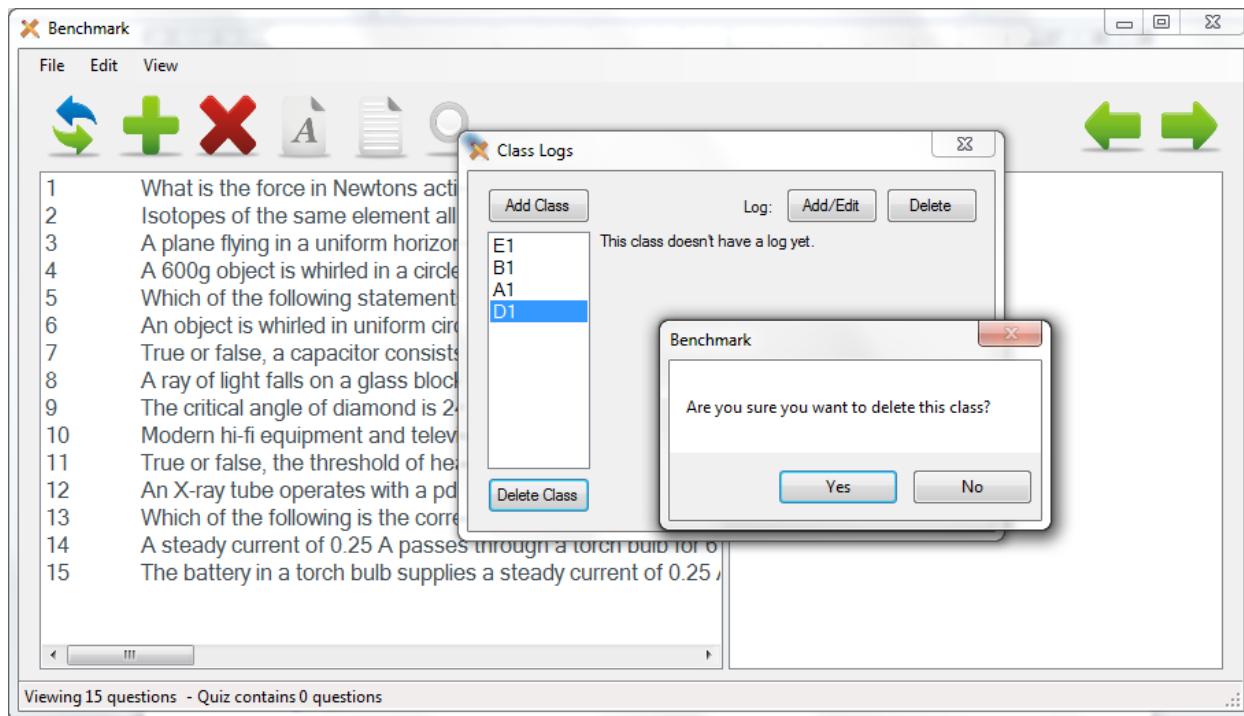
28



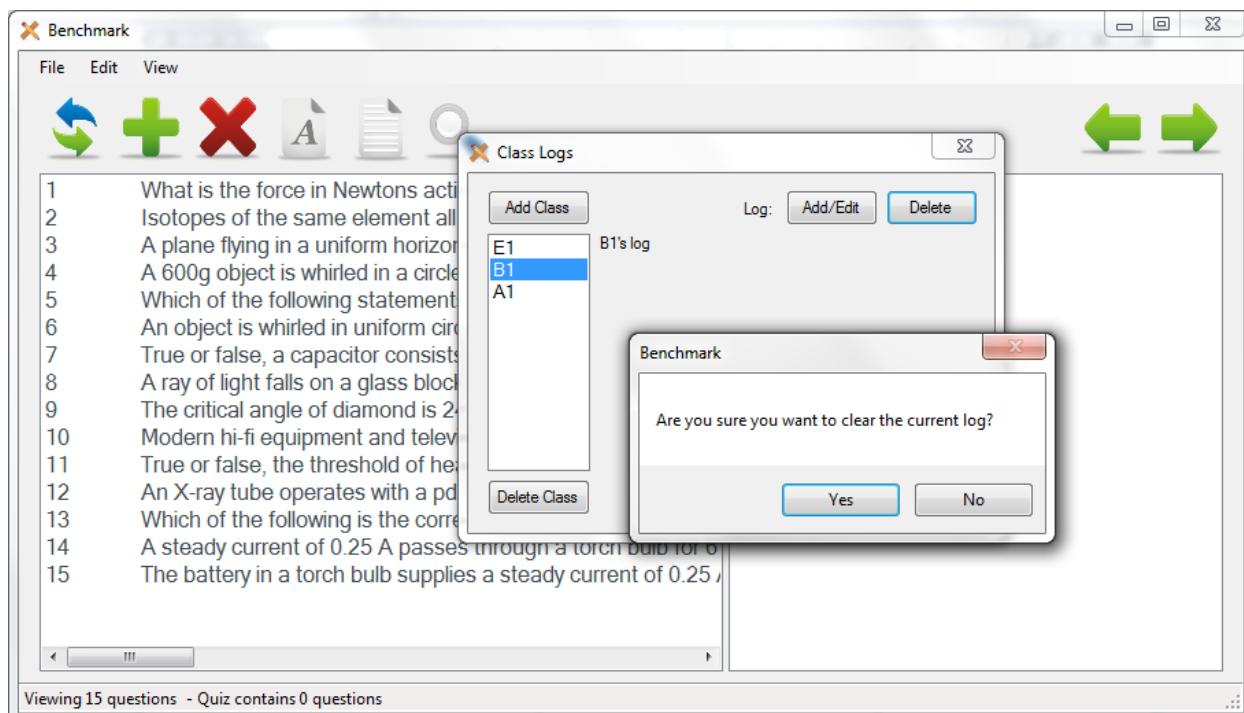
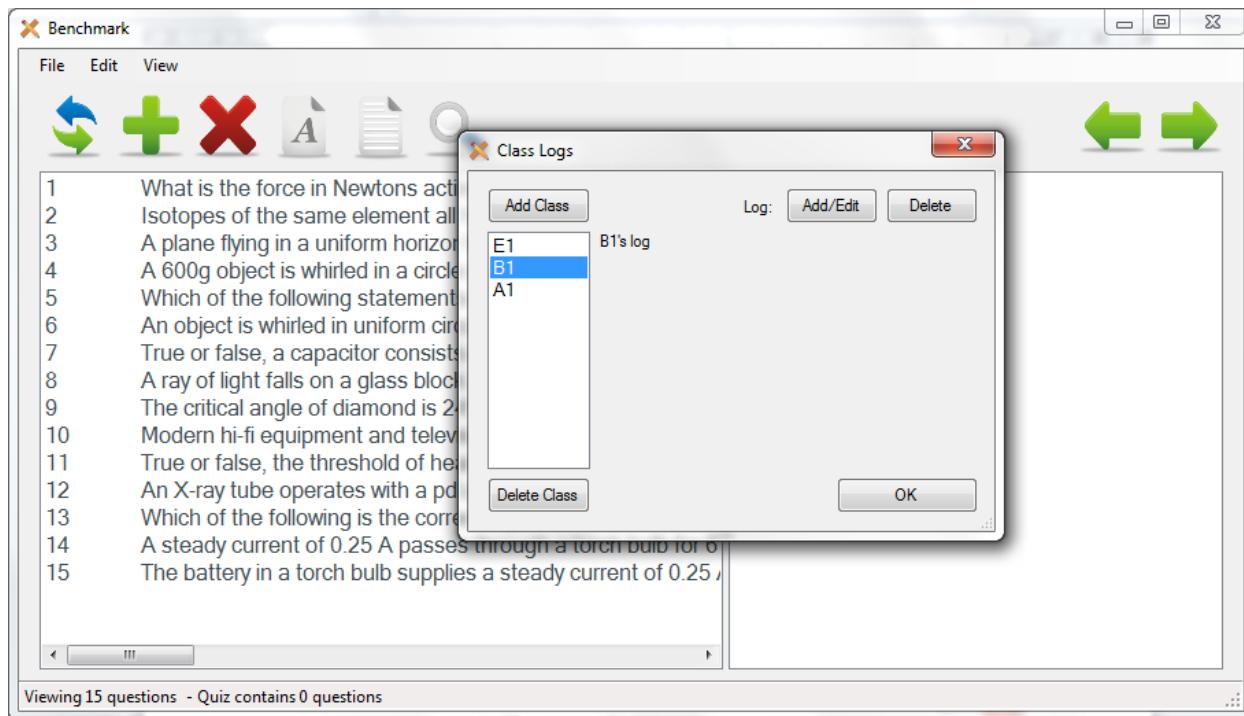
29



30



31



**Benchmark**

File Edit View

1 What is the force in Newtons acting on a body if its momentum changes by 16 kgms<sup>-1</sup> in 4 seconds?(1 mark[s])  
 2 Isotopes of the same element all have the same:  
 3 A plane flying in a uniform horizontal circle at constant speed and height:  
 4 A 600g object is whirled in a circle at a constant speed.  
 5 Which of the following statements is true?  
 6 An object is whirled in uniform circular motion.  
 7 True or false, a capacitor consists of two parallel metal plates.  
 8 A ray of light falls on a glass block at an angle of incidence of 45°.  
 9 The critical angle of diamond is 24.4°.  
 10 Modern hi-fi equipment and televisions often have volume controls which allow the sound volume to be increased in steps. If each of these steps produces an increase in the sound intensity level of 2.0 dB, calculate the ratio by which the sound intensity is increased for each step up in volume.(3 mark[s])  
 11 True or false, the threshold of hearing is 0 dB.  
 12 An X-ray tube operates with a potential difference of 100 kV.  
 13 Which of the following is the correct symbol for current density?  
 14 A steady current of 0.25 A passes through a torch bulb for 0.5 hours.  
 15 The battery in a torch bulb supplies a steady current of 0.25 A.

**Class Logs**

Add Class Log: Add/Edit Delete

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E1  
B1  
A1

Delete Class OK

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32

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Documents Music Pictures Videos

Homegroup Computer

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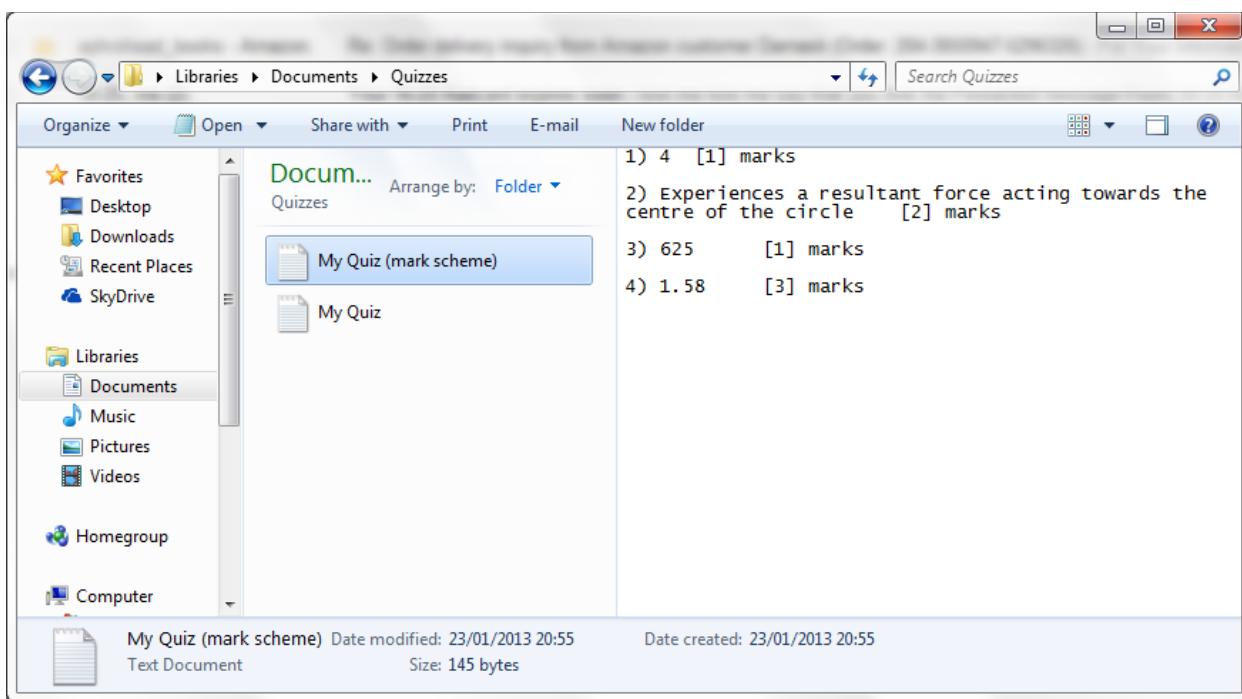
My Quiz (mark scheme)

My Quiz

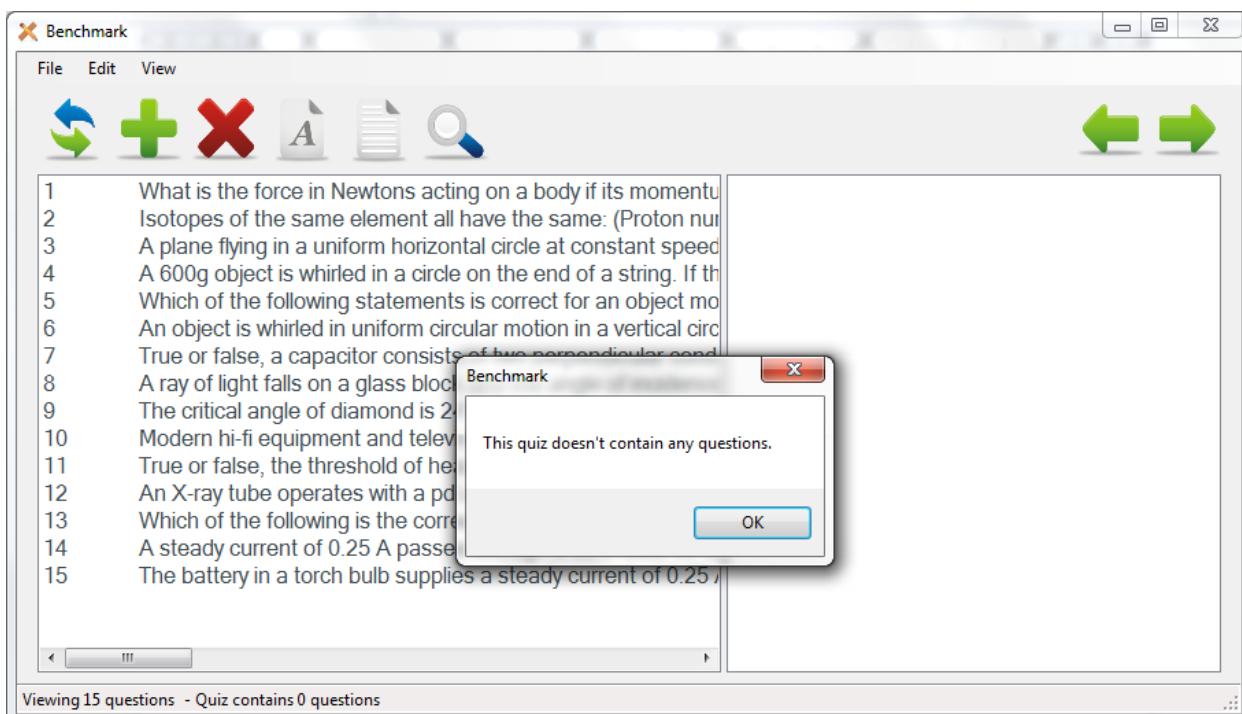
1) what is the force in Newtons acting on a body if its momentum changes by 16 kgms<sup>-1</sup> in 4 seconds?(1 mark[s])  
 2) A plane flying in a uniform horizontal circle at constant speed and height: (2 mark[s])  
 a) Has no resultant force acting on it  
 b) Experiences a resultant force acting away from the centre of the circle  
 c) Experiences an increasing force acting towards the centre of the circle  
 d) Experiences a resultant force acting towards the centre of the circle  
 3) what absolute or kelvin temperature is equivalent to 351.85°C?(1 mark[s])  
 4) Modern hi-fi equipment and televisions often have volume controls which allow the sound volume to be increased in steps. If each of these steps produces an increase in the sound intensity level of 2.0 dB, calculate the ratio by which the sound intensity is increased for each step up in volume.(3 mark[s])

My Quiz Date modified: 23/01/2013 20:55 Date created: 23/01/2013 20:55

Text Document Size: 868 bytes



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File Edit View

Benchmark

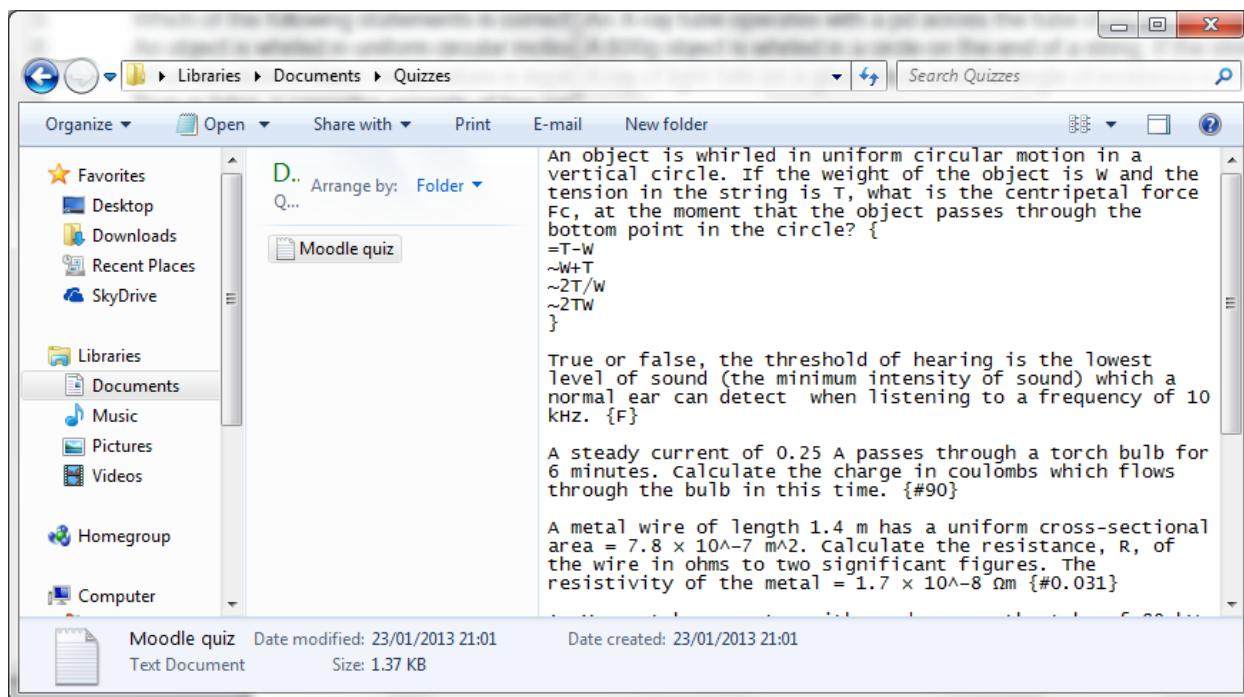
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 2 Isotopes of the same element all have the same: (Proton nul  
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 4 A 600g object is whirled in a circle on the end of a string. If th  
 5 Which of the following statements is correct for an object mo  
 6 An object is whirled in uniform circular motion in a vertical circ  
 7 True or false, a capacitor consists of two perpendicular cond  
 8 A ray of light falls on a glass block  
 9 The critical angle of diamond is 24°  
 10 Modern hi-fi equipment and television sets use  
 11 True or false, the threshold of hearing is 0 dB  
 12 An X-ray tube operates with a pd of 10 kV  
 13 Which of the following is the correct symbol for a  
 14 A steady current of 0.25 A passes through a wire  
 15 The battery in a torch bulb supplies a steady current of 0.25 A

This quiz doesn't contain any questions.

OK

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34



DAMI: Import questions f x https://moodle.godalming.ac.uk/learning/question/import.php

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Quiz Questions Categories Import Export

Parsing questions from import file.

Importing 7 questions from file

1. An object is whirled in uniform circular motion in a vertical circle. If the weight of the object is W and the tension in the string is T, what is the centripetal force  $F_c$ , at the moment that the object passes through the bottom point in the circle?

2. True or false, the threshold of hearing is the lowest level of sound (the minimum intensity of sound) which a normal ear can detect when listening to a frequency of 10 kHz.

3. A steady current of 0.25 A passes through a torch bulb for 6 minutes. Calculate the charge in coulombs which flows through the bulb in this time.

4. A metal wire of length 1.4 m has a uniform cross-sectional area =  $7.8 \times 10^{-7} \text{ m}^2$ . Calculate the resistance, R, of the wire in ohms to two significant figures. The resistivity of the metal =  $1.7 \times 10^{-8} \Omega\text{m}$

5. An X-ray tube operates with a pd across the tube of 80 kV. At the working pd of 80 kV, the anode current was 120 mA. The X-ray tube has an efficiency of 0.70 %. Calculate the rate of production of heat at the anode in kW.

6. A 600g object is whirled in a circle on the end of a string. If the string is 0.5m long and the force in the string is 4.8N, what is the speed of the object in  $\text{ms}^{-1}$ ?

7. A ray of light falls on a glass block and the angle of incidence is  $45^\circ$ . If the angle of refraction is  $30^\circ$ , what is the refractive index of glass?

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**1** An object is whirled in uniform circular motion in a vertical circle. If the weight of the object is  $W$  and the tension in the string is  $T$ , what is the centripetal force  $F_c$ , at the moment that the object passes through the bottom point in the circle?  
Marks: -/1

Choose one answer.

a.  $2TW$   
 b.  $2T/W$   
 c.  $W+T$   
 d.  $T-W$

[Submit](#)

**2** A 600g object is whirled in a circle on the end of a string. If the string is 0.5m long and the force in the string is 4.8N, what is the speed of the object in  $\text{ms}^{-1}$ ?  
Marks: -/1

Answer:

[Submit](#)

**3** A metal wire of length 1.4 m has a uniform cross-sectional area =  $7.8 \times 10^{-7} \text{ m}^2$ . Calculate the resistance,  $R$ , of the wire in ohms to two significant figures. The resistivity of the metal =  $1.7 \times 10^{-8} \Omega\text{m}$   
Marks: -/1

Answer:

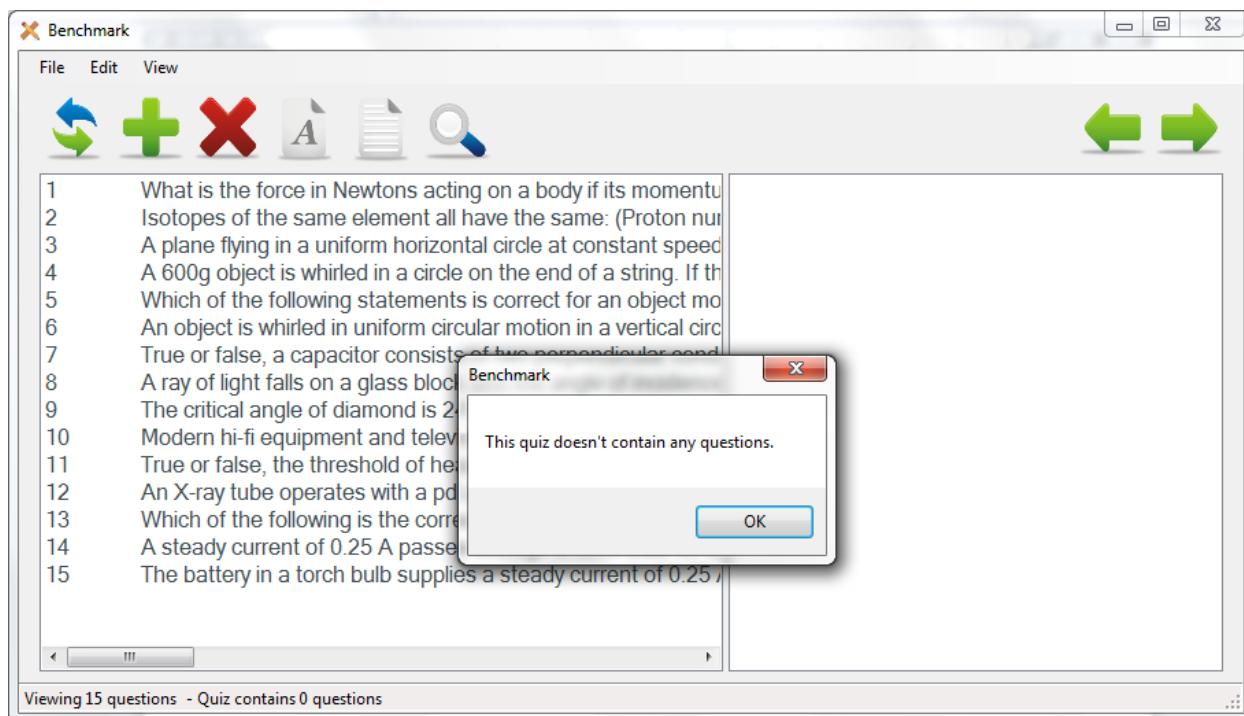
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**4** A ray of light falls on a glass block and the angle of incidence is  $45^\circ$ . If the angle of refraction is  $30^\circ$ , what is the refractive index of glass?  
Marks: -/1

Answer:

[Submit](#)

35



36

Questions - Notepad

File Edit Format View Help

```
what is the force in Newtons acting on a body if its momentum changes by 10 N s^-1?
NU
4

PHYA2 - Mechanics, Materials and Waves
Mechanics
1
Isotopes of the same element all have the same:
MC
Proton number
Neutron number
Mass number
Decay constant
PHYA1 - Particles, Quantum Phenomena and Electricity
Particles and Radiation
1
A plane flying in a uniform horizontal circle at constant speed and
MC
Experiences a resultant force acting towards the centre of the circle
Has no resultant force acting on it
Experiences a resultant force acting away from the centre of the circle
Experiences an increasing force acting towards the centre of the circle
PHYA4 - Fields and Further Mechanics
Further Mechanics
2
```

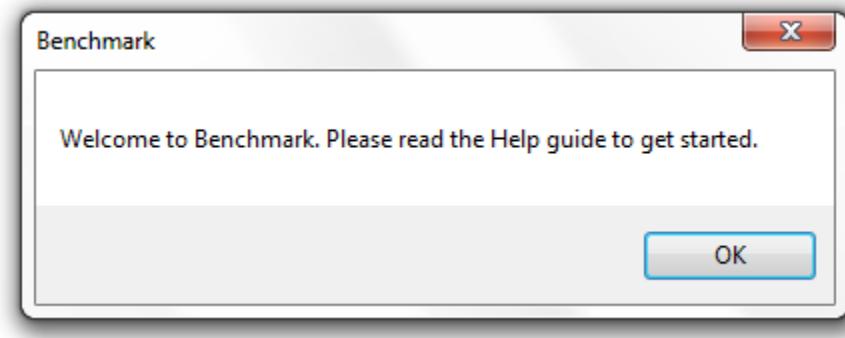
Benchmark

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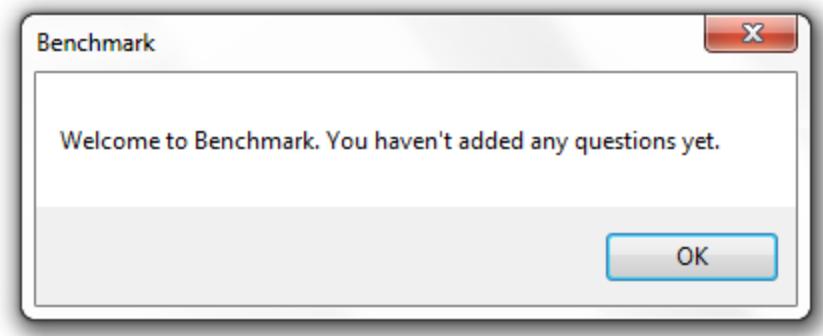
1	What is the force in Newtons acting on a body if its momentum changes by 10 N s <sup>-1</sup> ?
2	Isotopes of the same element all have the same: (Proton number, Neutron number, Mass number, Decay constant)
3	A plane flying in a uniform horizontal circle at constant speed and
4	A 600g object is whirled in a circle on the end of a string. If the string breaks, what happens to the object?
5	Which of the following statements is correct for an object moving in uniform circular motion?
6	An object is whirled in uniform circular motion in a vertical circle. At the top of the circle, the object is:
7	True or false, a capacitor consists of two perpendicular conductors.
8	A ray of light falls on a glass block and the angle of incidence is 45°. What is the critical angle of diamond?
9	The critical angle of diamond is 24°. What is its refractive index?
10	Modern hi-fi equipment and televisions often have volume controls. These are examples of:
11	True or false, the threshold of hearing is the lowest level of sound that can be heard.
12	An X-ray tube operates with a pd across the tube of 80 kV. A current of 0.25 mA passes through the tube. What is the power dissipated in the tube?
13	Which of the following is the correct equation for the work function of a metal?
14	A steady current of 0.25 A passes through a torch bulb for 6 hours. How much energy is supplied to the bulb?
15	The battery in a torch bulb supplies a steady current of 0.25 A. If the current is increased to 0.5 A, what will happen to the brightness of the bulb?

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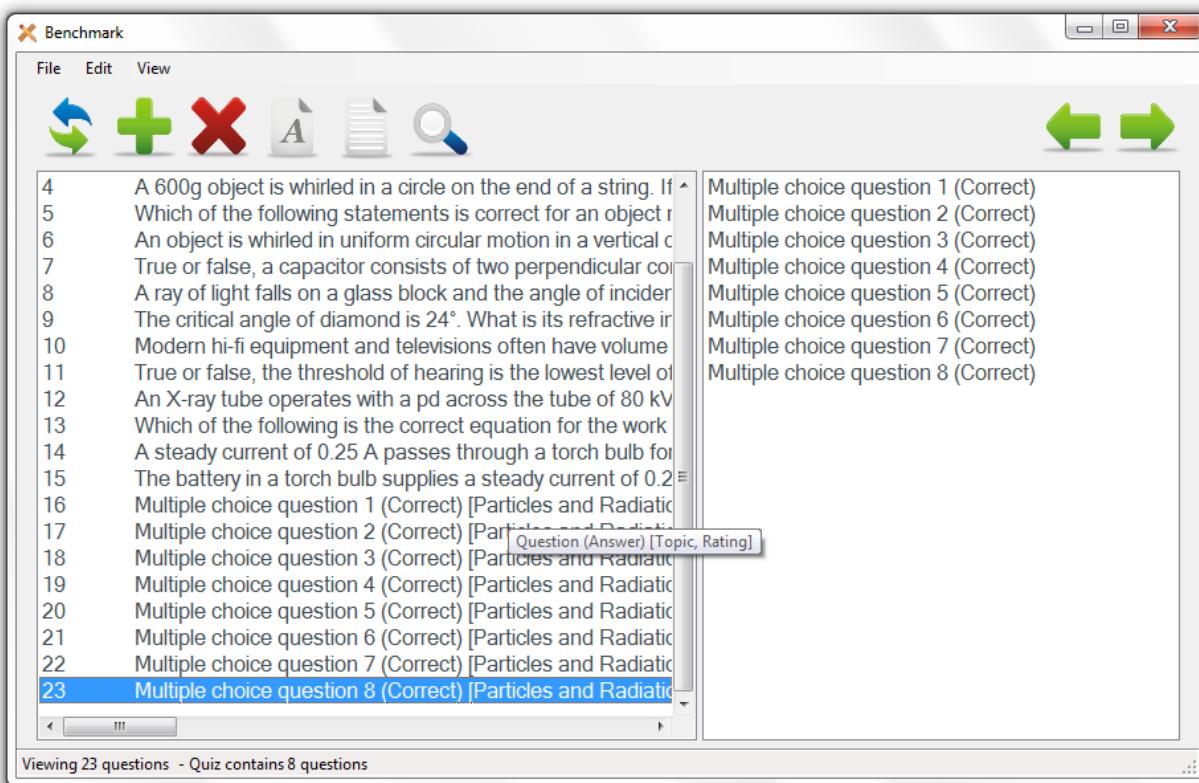
37



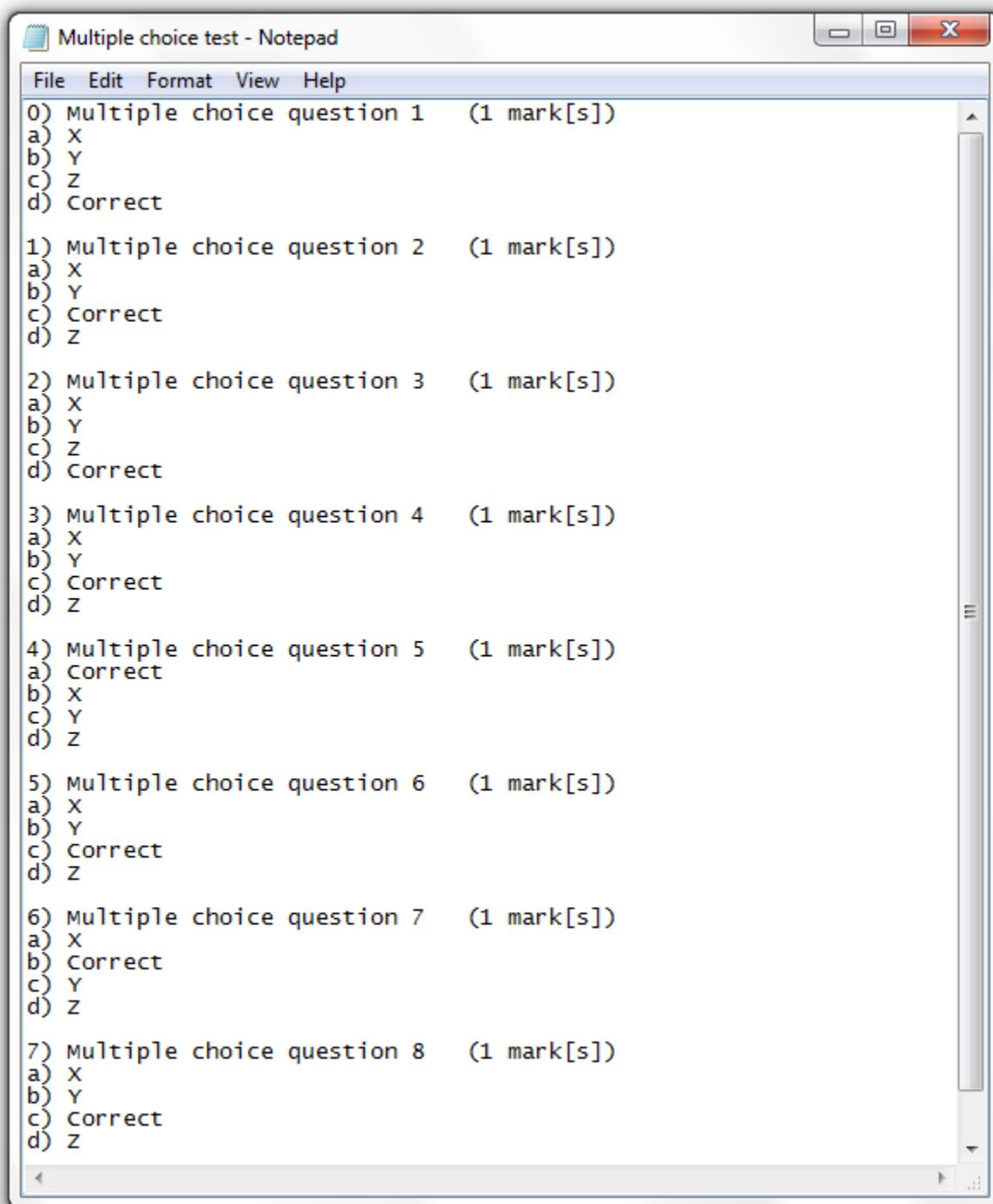
38



39



The screenshot shows a window titled "Benchmark" with a toolbar at the top containing icons for file operations, a circular arrow, addition (+), subtraction (-), multiplication (x), division (A), document, and search. Below the toolbar is a menu bar with "File", "Edit", and "View". On the right side of the window are two large green arrows pointing left and right. The main area contains a list of 23 questions numbered 4 to 26. Questions 4 through 11 are multiple choice, while 12 through 26 are labeled "Multiple choice question 1 (Correct)" through "Multiple choice question 8 (Correct)". A tooltip "Question (Answer) [Topic, Rating]" appears over the question number 18. At the bottom of the list, there are navigation buttons for "First", "Previous", "Next", and "Last". The status bar at the bottom indicates "Viewing 23 questions - Quiz contains 8 questions".



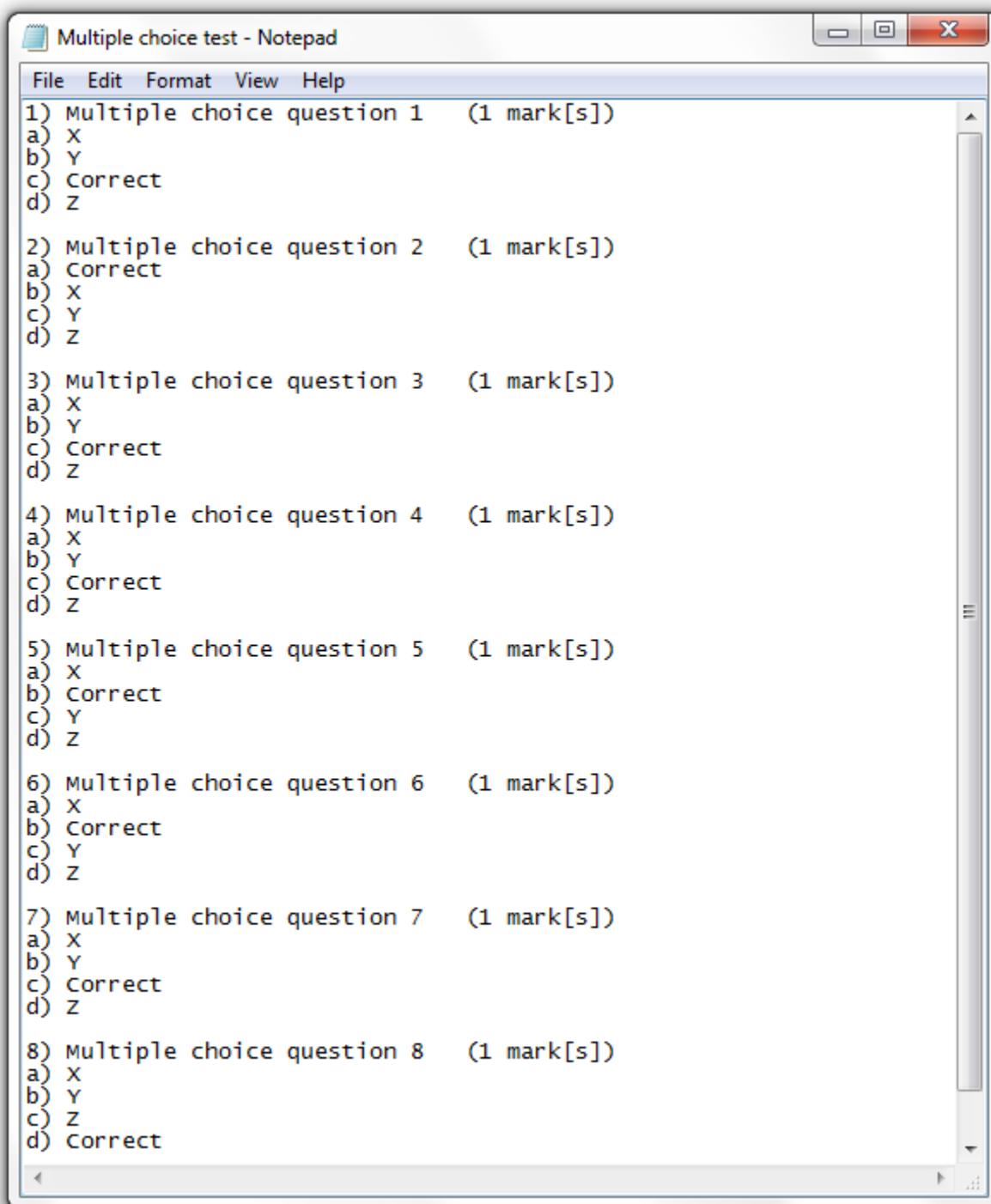
**Benchmark**

File Edit View

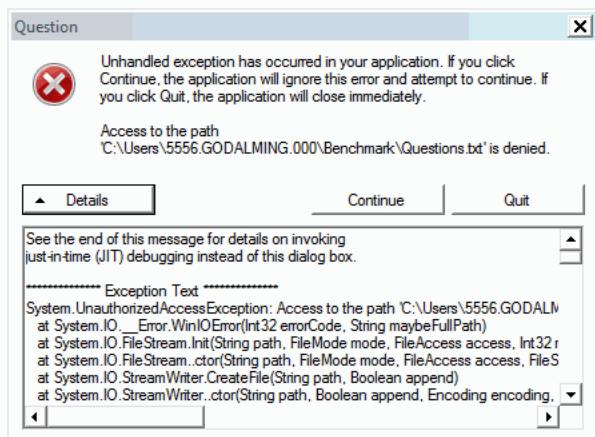
← →

1	What is the force in Newtons acting on a body if its momentum is 10 kg m s⁻¹ and its velocity is 2 m s⁻¹?	Multiple choice question 1 (Correct)
2	Isotopes of the same element all have the same: (Proton number, Neutron number, Mass number, Electron number, All of the above)	Multiple choice question 2 (Correct)
3	A plane flying in a uniform horizontal circle at constant speed has a centripetal acceleration pointing towards the centre of the circle. (True or false)	Multiple choice question 3 (Correct)
4	A 600g object is whirled in a circle on the end of a string. If the string is 1.5m long and the object moves at 2.5 m s⁻¹, what is the tension in the string? (Assume g = 10 m s⁻²)	Multiple choice question 4 (Correct)
5	Which of the following statements is correct for an object moving in uniform circular motion? (A) The object's velocity is constant; (B) The object's acceleration is constant; (C) The object's angular velocity is constant; (D) The object's linear velocity is constant.	Multiple choice question 5 (Correct)
6	An object is whirled in uniform circular motion in a vertical circle. At the top of the circle, the object has a centripetal acceleration pointing downwards. (True or false)	Multiple choice question 6 (Correct)
7	True or false, a capacitor consists of two perpendicular conductors separated by a dielectric material.	Multiple choice question 7 (Correct)
8	A ray of light falls on a glass block and the angle of incidence is 45°. The critical angle of diamond is 24°. What is its refractive index?	Multiple choice question 8 (Correct)
9	Modern hi-fi equipment and televisions often have volume controls which are logarithmic. (True or false)	
10	The threshold of hearing is the lowest level of sound that can be detected by the human ear. (True or false)	
11	An X-ray tube operates with a pd across the tube of 80 kV. A current of 10 mA passes through it. (True or false)	
12	Which of the following is the correct equation for the work function of a metal? (A) $W = \frac{1}{2}mv^2$ ; (B) $W = qV$ ; (C) $W = qV^2$ ; (D) $W = qV^2$ .	
13	A steady current of 0.25 A passes through a torch bulb for 6 hours. (True or false)	
14	The battery in a torch bulb supplies a steady current of 0.25 A. (True or false)	
15	Multiple choice question 1 (Correct) [Particles and Radiation, Electromagnetic Waves]	
16	Multiple choice question 2 (Correct) [Particles and Radiation, Electromagnetic Waves]	
17	Multiple choice question 3 (Correct) [Particles and Radiation, Electromagnetic Waves]	
18	Multiple choice question 4 (Correct) [Particles and Radiation, Electromagnetic Waves]	
19	Multiple choice question 5 (Correct) [Particles and Radiation, Electromagnetic Waves]	
20	Multiple choice question 6 (Correct) [Particles and Radiation, Electromagnetic Waves]	
21	Multiple choice question 7 (Correct) [Particles and Radiation, Electromagnetic Waves]	
22	Multiple choice question 8 (Correct) [Particles and Radiation, Electromagnetic Waves]	
23	Multiple choice question 8 (Correct) [Particles and Radiation, Electromagnetic Waves]	

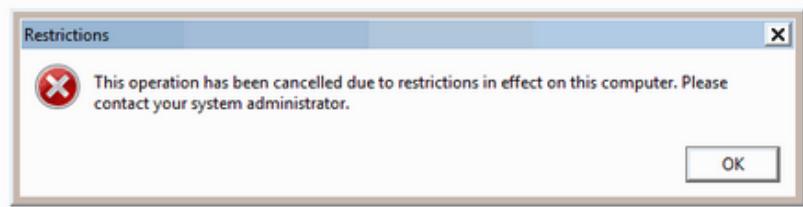
Viewing 23 questions - Quiz contains 8 questions



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45

